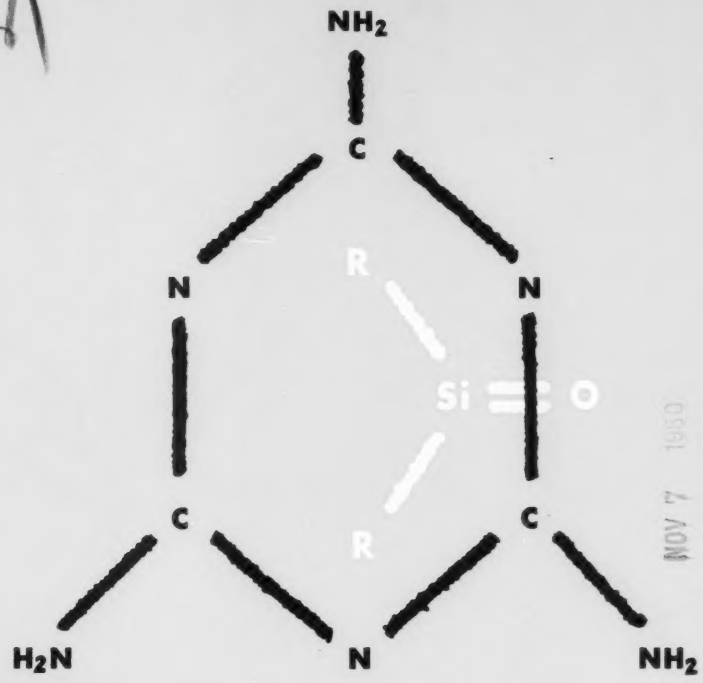
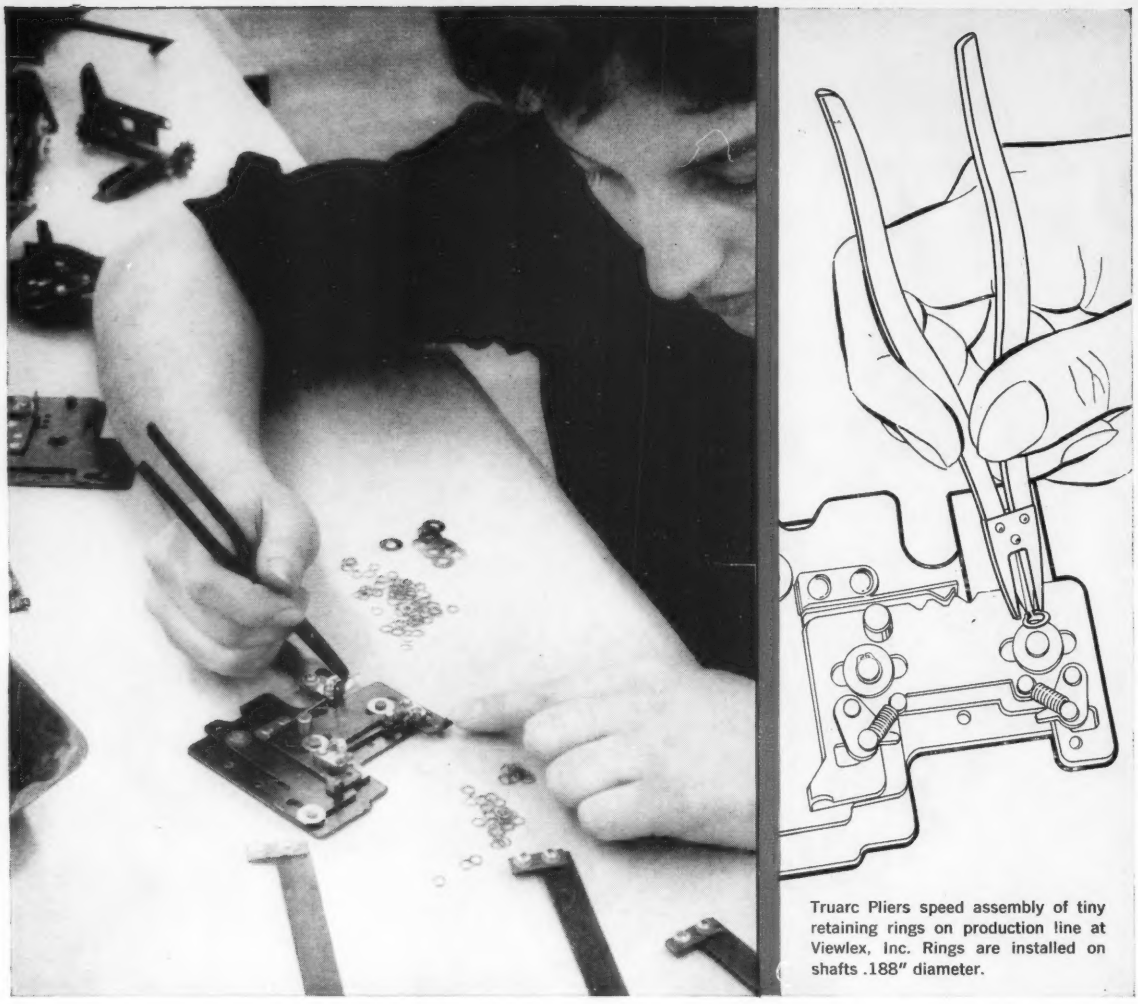
Design Engineering

FIVE DOLLARS A YEAR PUBLISHED BY THE MACLEAN HUNTER PUBLISHING COMPANY LIMITED, TORONTO, CANADA **NOVEMBER 1960**



Plastics on the move in Canada...

...materials
...processes
...applications



Truarc Pliers speed assembly of tiny retaining rings on production line at Viewlex, Inc. Rings are installed on shafts .188" diameter.

Truarc rings eliminate rejects, cut assembly time 40%

Production engineers at Viewlex, Inc., Long Island City, N.Y., save time, speed work with Waldes Truarc retaining rings.

On Viewlex Instruct-O-Matic automatic slide projector, the top plate assembly utilizes five Truarc Series 5100-18 external rings to secure the lost motion plate to the base.

Operator above uses Truarc Standard Plier No. 0018 for installation and removal of rings in accurately located grooves, pre-cut before the assembly is made. Precision engineered plier tips grasp tiny rings securely to speed assembly and disassembly. Pliers are pre-set to avoid over-spreading the rings.

The original design of the unit called for shoulder rivets. In addition to requiring a longer stud, the rivets were difficult to control for height consistency. As a result, when the rivets were flattened, binding or looseness between the plates often caused expensive rejects. For maintenance of the unit, it was necessary to scrap the entire assembly.

Use of Truarc rings assures precise seating of the plates and eliminates rejects caused by faulty riveting. Result: an assembly time saving of 40% at Viewlex. Use of Truarc rings may achieve similar or greater savings—in labor, machining or parts—on your production lines. These versatile fasteners come in 50 functionally different types, as many as 97 sizes within a type, 6 metals, 13 finishes.

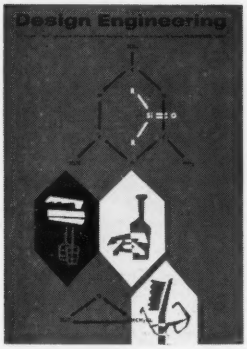
They replace nuts and bolts, machined shoulders, threaded collars and set screws, bowed washers or springs and cotter pins, and other fasteners and fastening operations. (A wide line of semi-automatic and manual Truarc tools are available to speed ring assembly). For facts on the entire line of rings, tools and application ideas, write for the new Waldes Truarc catalogs: RR 10-58 and AT 10-58.

Available in Canada from: LYMAN TUBE AND BEARINGS, LIMITED

Head Office: 5420 Pare Street, Montreal 9, Quebec.
Branch Offices: Toronto, Winnipeg, Vancouver, New Glasgow, N. S.

WALDES TRUARC® RETAINING RINGS
Waldes Kohinoor, Inc., Long Island City 1, N.Y.

TRUARC RETAINING RINGS...THE ENGINEERED FASTENING METHOD FOR REDUCING MATERIAL, MACHINING AND ASSEMBLY COSTS



This month's cover

Once again artist Gerald Bern has come up with a tantalizing cover to set the mood for a special issue of DE, this time on the theme of plastics. We understand from Gerry that the inspiration to include a food mixer, telephone, toothbrush, spectacles and a bottle in the design came from a look about his own home for products made of plastic.

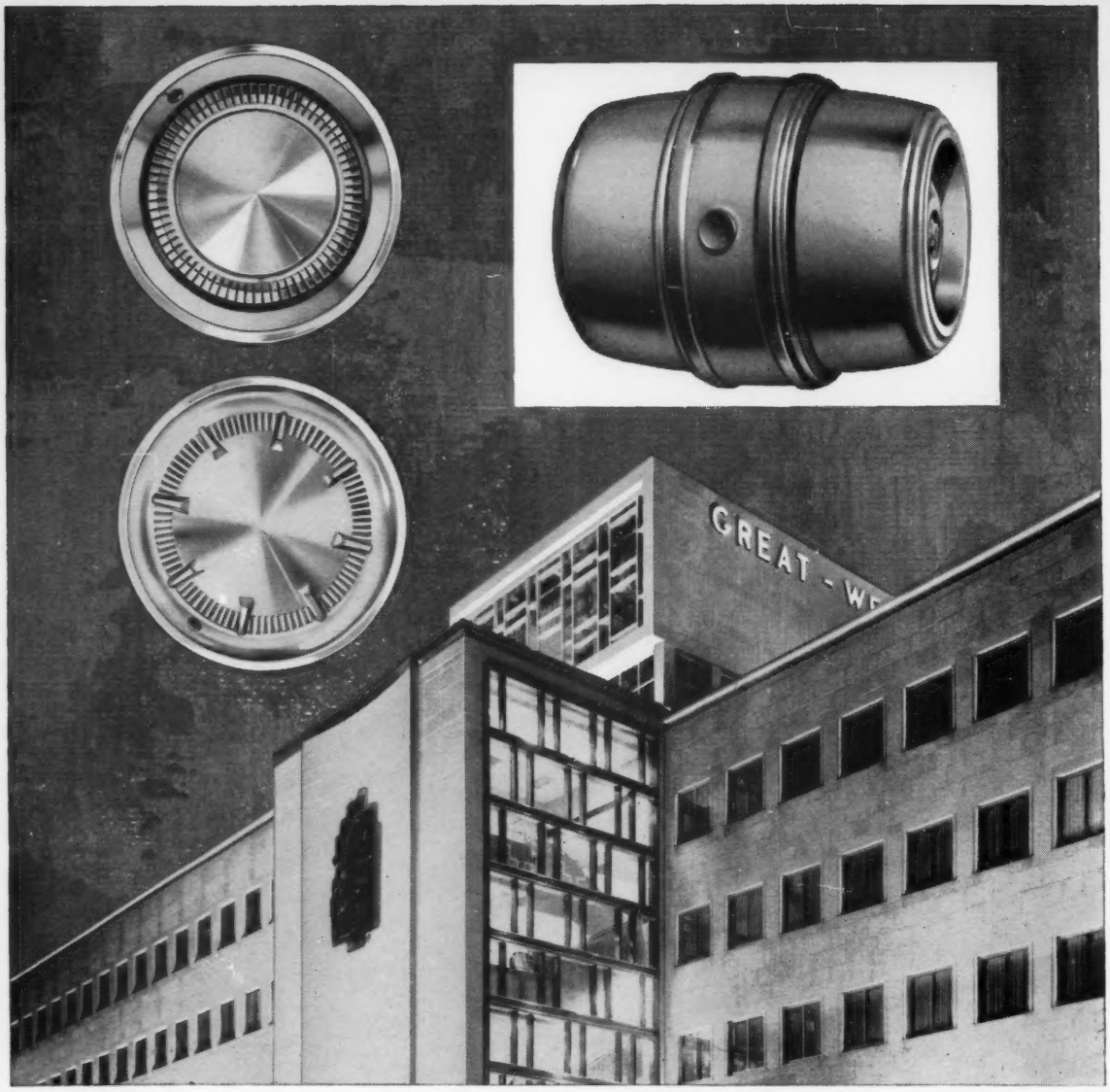
In this issue

Departments

Reader Service

Before reading further, turn to the back of the book and tear out a Reader Service Card. Circle the numbers as you go and mail the completed card to us—no postage is required. We will take care of your requests immediately.

Pass your copy along so that others may enjoy this service—there are three cards.



EVERY CANADIAN INDUSTRY HAS SOLVED TOUGH PROBLEMS WITH STAINLESS STEEL FROM ATLAS

A new product means new problems—and wherever possible design engineers solve these problems with proven materials. That's why stainless steel has been used by every manufacturing industry in Canada.

What do designers like about stainless steel? First of all stainless is easy to work with. No tolerance is needed for corrosion because there *is* no corrosion — and stainless needs no painting or plating. But probably the biggest asset is the acceptance both industry and the consumer have for stainless.

Investigate the possibilities of using stainless in *your* next project. You'll be pleasantly surprised at the number of expensive operations that can be eliminated.

In Canada the largest producer of Stainless Steels—and the company best equipped to assist you—is Atlas. For answers to your questions about steel, contact your nearest Atlas representative.

ATLAS STAINLESS STEELS

ATLAS STEELS LIMITED, WELLAND, ONT. Warehouses: MONTREAL, TORONTO, HAMILTON, WINDSOR, WINNIPEG, VANCOUVER. Representatives: LONDON, ST. CATHARINES, SUDBURY

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The staff

The contributors

Unusual hobbies, recreations and interests occupy our page this month.

One of the rarest we've ever come across is listening. Listening to what? we asked. Listening to anything, replied **Brian H. Gambrill,** co-author of the article on rigid vinyl sheeting.

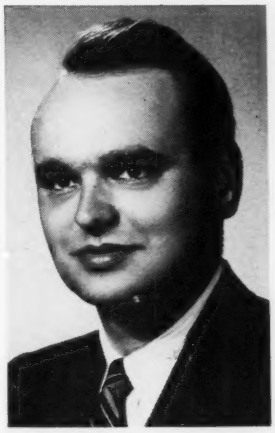
"My listening is wide in scope," explains Brian. "I like listening to the early morning traffic of great cities like New York and London. I like listening to express trains, to the wind in the autumn leaves, even to the rain.

"I listen to music, from Byrd to Berg, but especially Bach, Teleman, Vivaldi, Strauss (Richard and occasionally Johann) and Stravinsky. And particularly I like listening to good conversation."

Brian is a development chemist at Shawinigan Chemicals Ltd. He studied at the University of London (his home town), where he collected a B.Sc. degree in agriculture, and at McGill, where he did a year's research. In 1956 he joined Canadian Resins & Chemicals, now a division of Shawinigan. He and his Austrian born wife Otti have two daughters, Alexandra, aged three, and Judith, aged one.

Gambrill

Pegram



Littlejohn

His colleague and co-author, **John Pegram,** also has an unusual hobby. He caves.

Caving, explains John, is the practice of entering caves (which he defines as any natural cavity in rock underground or leading underground). Hydrology, geology, minerology, biology, photography and palaeontology are some of the varied activities comprising cave science.

Some cavers, he goes on, like to make the sport more difficult by carrying large amounts of bulky surveying equipment. Those who prefer easy caving just carry a pair of scales and a pocket full of aluminum tags. Why scales and tags? To weigh bats, of course!

Before joining Shawinigan Chemicals, he was with Imperial Chemical Industries Ltd. in the plastics division. He holds the Plastics Institutue diploma in plastics technology and polymer chemistry. He is 27 and unmarried.

Somewhat different is the diversion of **John H. Woodruff,** who wrote the article on custom molded plastics. He is a devoted member of the Young Presidents' Organization, which, as you may know, is restricted to executives who have become presidents of their companies by the age of 40. Other requirements for membership are that the company, if manufacturing, has to do over one million dollars in gross sales and have at least 50 employees, or if service, over two million and have 25 employees. At the age of 49 members have to retire from the organization.

Mr. Woodruff is president of Auburn Plastics Inc., Auburn, N.Y., a business founded by his grandfather in 1876. He graduated from Yale with a B.Sc. degree and then took a graduate course in business administration at Columbia.

Our next two authors, alas, have no hobbies more interesting than golf. **Edward L. Littlejohn,** who wrote the introductory and keynote article for this month's plastics issue, says he hardly has time even for golf. He is assistant to the general manager of the Visking Division of Union Carbide Canada Ltd. A University of Toronto graduate (B.A.Sc.), he is an active member of the Society of Plastics Industry (Canada) Inc. and is currently chairman of the public relations committee. Public relations is a subject of special interest to him as he was PR manager for Union Carbide for two years before receiving his present appointment in 1958.

J. P. Pritchard, who discusses the cost economies of vacuum forming, adds to golf curling, reading, gardening and woodworking. He is assistant general manager of G. M. Plastic Corp., Granby, Que. A native of Winnipeg, he moved to Montreal as a boy and graduated from McGill with a B.Sc. degree (chemistry) in 1949.

THE NEW GIANT FOR INDUSTRY...
THAT STANDS WAIST HIGH TO A GROWING BOY!

NEW BLOOD BROTHERS "150WB" UNIVERSAL JOINT

HAS AN ULTIMATE YIELD OF 600,000 INCH POUNDS OF TORQUE... WITH A SWING DIAMETER OF ONLY 13½ INCHES!

The boy in the picture is holding one of Blood Brothers' smaller universal joints to show the relative size of its giant new "150WB." One of the largest universal joints ever built commercially, it will adequately handle 162,000 inch pounds of torque using a safety factor of 10 to 1 . . . in a swing diameter of only 13½ inches! The "150WB" was designed for compact installation in such operations as rolling mills, gantry cranes and ship drive shaft applications. In spite of its size, this giant unit may be assembled or disassembled by removing 4 bolts.

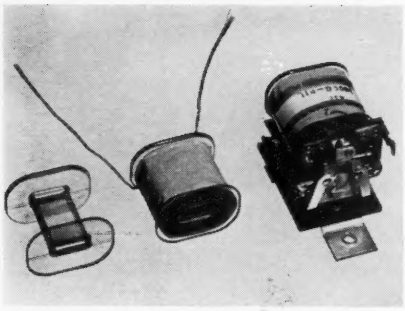
The "150WB" proves again that you can get the exact universal joint you need from one source . . . anything you need from a simple assembly built to handle 350 inch pounds of torque, to the "giant" in the industry. Whatever your requirements, either a standard item, or an unusual design for a special application, Rockwell-Standard engineers can meet your specifications . . . at a considerable saving in cost. Write or call for complete details today!

Another Product of... ROCKWELL-STANDARD CORPORATION

Universal Joint Division, Allegan, Michigan

For further information mark No. 160 on Readers' Service Card

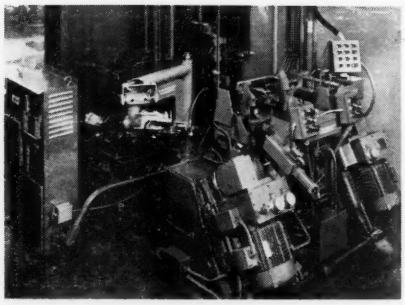
Watch Lexan! It opens new design doors



A transparent thermoplastic which has just gone itno production in Indiana is said to be one of the most important materials developed in an American laboratory in the last decade, and to have an almost unlimited future. Lexan polycarbonate resin has outstanding impact resistance and dimensional stability; it has good electrical qualities and resists staining, humidity and many chemicals. It is a good replacement for metals in various applications. It can be blow molded, extruded, vacuum formed and cold formed. It has wide uses in electrical and electronic component parts and is particularly well suited to coil form applications (left).

Circle 300 on Reader Service Card

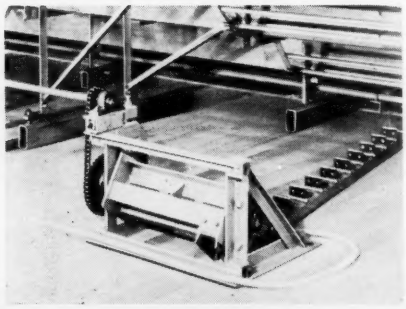
Canadian machine solves a peculiarly Canadian problem



A Canadian company has come up with a special purpose machine to meet a typically Canadian problem of limited production. Used in the automotive industry, the machine serves for the final balancing of engines, both passenger and truck, with or without torque converter. For engines without torque converters, balancing is accomplished by removing precise amounts of material from the fan pulley at one end of the crankshaft and from the flywheel at the other. For engines with converters, it is not possible to machine the flywheel, so true balance is accomplished by spot welding predetermined weights to the outside of the housing. The welding arm and equipment can be seen at the left end of the machine.

Circle 301 on Reader Service Card

Folding column transmits heavy loads, stores in small space



A unique design principle is embodied in this power-operated folding column. It rolls in or out to form a rigid column capable of pushing or pulling heavy loads linearly with a steady force. One of its principal advantages is that when rolled in, it occupies only a tiny percentage of its extended size. It has many applications. Its heavy load-moving ability makes it useful for ash scraping or for moving railroad cars. Because of its small size, it can be mounted inside trucks to push out heavy pallets. The column is formed of hinged links of steel or other channel, helically wound round a power-operated drum. The drum feeds out or withdraws the column to transmit large forces. As it unrolls, the column is completely rigid in three directions, but must roll out over a flat surface to provide rigidity in the fourth.

Circle 302 on Reader Service Card

he means a real big one!

And he'll get a sundae that will match his appetite. It probably will be "big"! But big or not it will be exactly what he wanted. Same thing with ordering a machine from us. Whether it's a real big one—not so big— or a multiple small unit order, it will be exactly what you wanted. After all, building machinery to exact specifications is our business—and we've been doing it for more than a generation.

For capital equipment needs call Canada Iron. Here's why:

- In Trois Rivieres and Toronto we have modern plants with the latest, most efficient machinery-building equipment
- We have an engineering staff with long experience. Metallurgical experts and constant research and development work that can be most helpful to you
- A production staff who build "by the book"! Never short cut quality and are proud of their reliability
- We have a host of satisfied customers representing a cross-section of "Who's Who" among North American manufacturers.

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CANADA IRON FOUNDRIES, LIMITED

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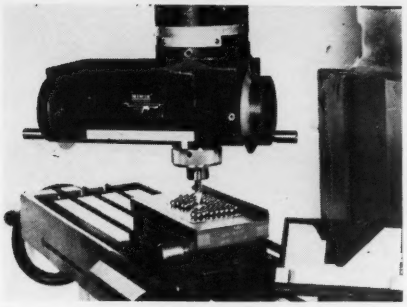
Canadian template cutter said cheapest for short runs



Tracing templates can now be cut directly from the drawing in 15 to 45 minutes with this attachment on a vertical milling machine. Such rapid template time removes one of the greatest obstacles to the tracing technique and makes this particular method possibly the fastest way to produce low-cost, high accuracy short runs. The attachment, known as a Templater, uses .003 in. shim stock. Dial settings provide for any angle or radius. It was developed by a Canadian company and is being manufactured at its plant in Galt, Ont., and at the plant of its U. S. subsidiary in Buffalo, N.Y. The company, Retor Developments Ltd., also has plans for expansion in Europe.

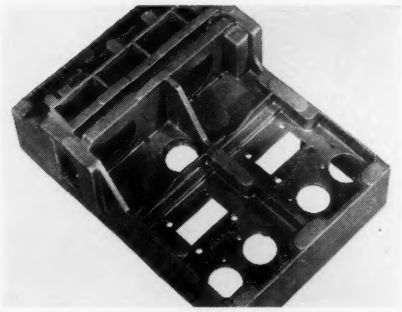
Circle 303 on Reader Service Card

New look for the rural mailbox

The alert designer finds opportunities in the most unexpected places. Who else would think of a new look for the commonplace rural mailbox? Actually hundreds, says the U. S. Post Office, which rejected all because they were impractical. (For instance, one had a line connected with the house, and this line sent the letters flying to the front door.) Then came a chance meeting between a manufacturer and a Detroit designer, William M. Schmidt. The manufacturer said he wanted a new product to keep his plant busy. Schmidt, seen here with the old, the new and the beautiful, suggested a rural mailbox. The post office approved and the manufacturer is now turning out 500 a day. Production will step up when the mailbox is listed in the mail order catalogues.

Circle 304 on Reader Service Card

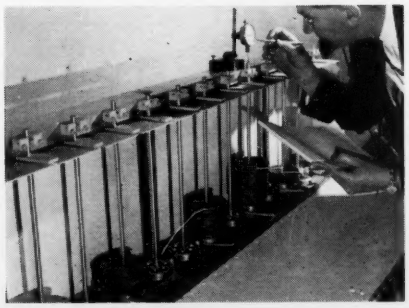
Machining time cut from eight weeks to one



This intricate part (a housing unit for a missile) used to take two months to machine. Now it takes only a week, and if the tolerances were not so precise it could be machined in much less time. The part is now investment cast by the relatively new ceramic shell investment casting process. Besides the considerable saving of time and the saving in cost, the process also offers greater flexibility of design. Thus, crossed slots in a hard-to-reach area used to be omitted, though they would have been desirable; now they are cast right into the part. Other critical dimensions also have been redesigned so that the full capabilities of investment casting can be achieved, including the casting of proved-out portions and experimental machining of other portions.

Circle 305 on Reader Service Card

Testing program on plastics cut from years to months



A test program on plastic laminate materials has been cut from years to months — and the cost cut to one sixth — at the Boeing Development Center. The program involved testing more than 1,000 specimens of epoxy laminate tooling materials at constant stresses from 3% to 50% of breaking load and for periods of 500 hours at room temperature and at 120F. Boeing designed a 15-unit flexural creep test machine which shaved five years and five months off the program. The unit consists of a six-foot rectangular metal case enclosing 15 loading rods. Weights of 1 lb and 5 lb, placed on the rods, apply the desired percentages of breaking loads to test specimens beneath the rods.

Circle 306 on Reader Service Card

MADE BY
DU PONT
IN CANADA
FROM CANADIAN MATERIALS

ZYTEL NYLON

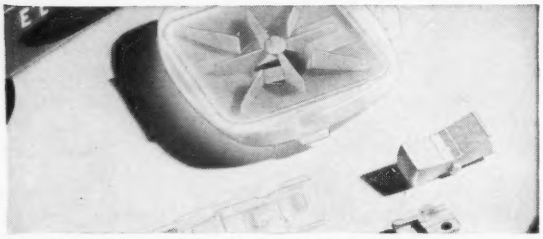
now costs less from domestic stocks

More and more mechanical parts are being moulded in Canada from Canadian-made "Zytel" nylon. Qualified moulders with years of experience in moulding this material can provide you with the best quotations and the best service available anywhere in the world. Consider these outstanding properties and call a Canadian moulder — he can help you to lower costs and improve performance — with "Zytel" nylon — Du Pont's outstanding engineering material.

- *Easily and economically moulded into finished parts.*
- *Models or prototypes easily machined from available stock shapes.*
- *Moving parts are quiet running.*
- *Nylon damps vibration and shock.*
- *Usually requires no lubrication.*
- *Low-friction.*
- *Little, if any, wear in contact with itself or metals.*
- *Lighter-weight than metals, stronger than other plastics.*
- *Can be moulded in color, dyed, painted or metalized.*
- *Can be cemented, spin-welded, solvent-welded, snap-fitted.*
- *Non-corrosive in most environments.*
- *Strong and tough, particularly in thin sections.*
- *Will take self-tapping screws.*
- *Electrical insulator.*

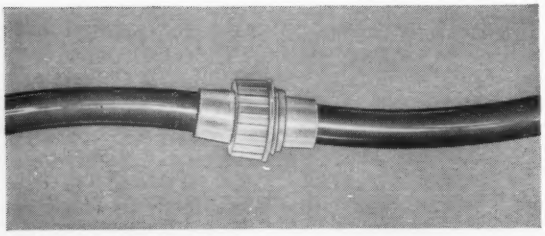
Du Pont's technical staff is available for discussions with designers and moulders concerning "ZYTEL" and other Du Pont high-quality plastics materials. Answers to your queries and free literature will be promptly provided on request.

THESE PARTS WERE DESIGNED AND MOULDED IN CANADA



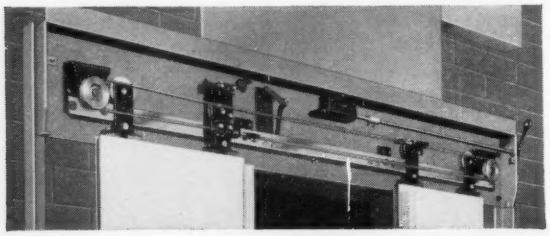
"ZYTEL" mouldings form key part of new Electrolux vacuum cleaner

Mouldings of "ZYTEL" were used for several important parts in the new "Elux-o-matic" vacuum cleaner. "ZYTEL" nylon parts were specified because the easy-moulding characteristics and high strength/weight ratio of "ZYTEL" could provide all the desired properties at the lowest cost.



Lower-priced hose couplings are moulded of "ZYTEL"

The high strength and durability of "ZYTEL" nylon is put to good use in this garden-hose coupling. It has become popular for its low pressure loss and ease of attaching and removing.



Silent elevator sliding door hangers of "ZYTEL"

Operating on sheaves of abrasion-resistant "ZYTEL" nylon resin revolving on permanently-lubricated "ZYTEL" ball-bearings, Turnbull "Quiet Glide" door hangers function with unmatched efficiency. Even when in continuous use, "ZYTEL" ensures reduction of track wear, long life, as well as reliable and extremely smooth performance.

DU PONT OF CANADA LIMITED, Plastics Division,

P.O. Box 660, Room A-4, Montreal, Quebec.

For further information mark No. 135 on Readers' Service Card

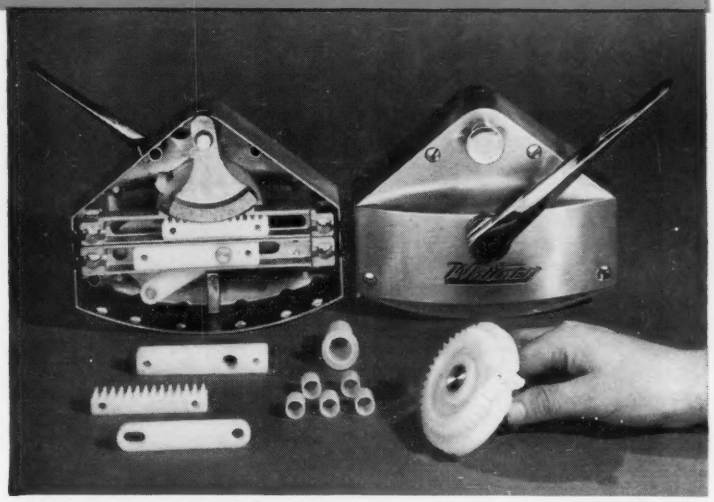
ZYTEL NYLON

helps create a new Canadian design

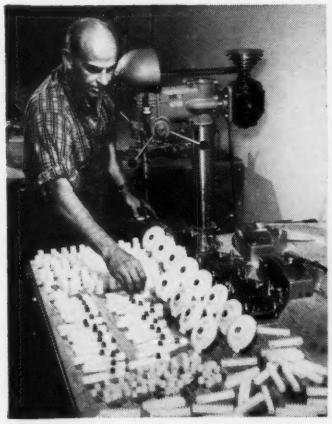
By redesign of conventional metal components to use "ZYTEL", the designer of this new boat control reduced the unit's weight to only nine pounds, eliminated corrosion of working parts as well as lubrication, and lowered the unit's cost considerably below that of similar equipment.

A test conducted by Canadian Applied Research Limited, Toronto, showed that after 200,000 operating cycles under full load, the "Whitney Automatic" revealed no defects, deterioration, or appreciable wear of ZYTEL* or other parts. *In fact, the only noticeable change at conclusion of the test was increased smoothness of operation — yet this test was equivalent to 100 years of normal boating!*

Injection moulding enables the design of fewer parts to do the same job and eliminates assembly operations. Moreover, the use of "ZYTEL" nylon's low friction characteristics, heat resistance, and lack of corrosion permits an unconditional guarantee of the "Whitney Automatic". *When asked why he decided to use "ZYTEL" in developing the unit, Mr. Buddo stated that he found "ZYTEL" the ideal answer to his problem of economy as well as mechanical efficiency.*



Front and back views of the new "Whitney Automatic". Its "ZYTEL" nylon components include a 3¾-inch gear rack, a throttle bar and drag link, a 3¾-inch main drive gear, 5½-inch bushings and a ¾-inch bushing moulded with a flange.



Assembly is simple. The 10 nylon parts, moulded by Midland Plastics, Midland, Ontario, from "ZYTEL" produced at Du Pont of Canada's Kingston, Ont., plant, make possible precision-engineering with no metal-to-metal contact.

Inventor C. W. Buddo (Left), president of Lake Controls Limited, Toronto, and Lake Controls Inc., Buffalo, discusses his single-lever outboard motor steering wheel control with John McDiarmid, chief engineer. The most recent innovation of the "Whitney Automatic" is to replace a brass pin on the throttle bar with nylon so that this unit is now moulded as a single piece, further streamlining production.

DU PONT CANADA

Better Things for Better Living ...through Chemistry

DU PONT PLASTICS

*Du Pont Trademark

as versatile as your imagination...

STAN STEEL TUBING

New advancements — new improvements in your products are limited only by the boundaries of creative imagination. You'll find that versatile welded steel tubing, fabricated for you by Standard Tube, can solve your design problems.

Let us help you with imaginative design planning for your products.

Aluminum Sheet, Bar, Extrusions, Tube and Wire also available in any quantity.

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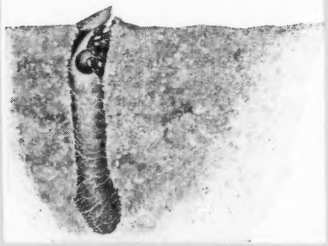

Underground Spinner. Not all spiders make webs. But all are skillful spinners of strong silk thread, for very different uses ranging from aerial "parachuting" to wrapping up prey. The trapdoor spider digs a deep hole, spins a gossamer coating for it, adds a hinged lid and lives securely in his silk-lined, expertly engineered burrow.

Tiny Thread Transducer. In textile weaving this new Mark III thread transducer — shown greatly reduced in size — helps eliminate moirè patterns by recording average and cyclic thread tension. Friction in the transducer's floating arbor is overcome by three MPB bearings cycled between 10,000 and 20,000 rpm 371 times per minute.

Man With Miracles. Like all MPB Sales Engineers, Harry Gabriel can tell you about the advantages MPB bearings are bringing to new, miniaturized devices like the Mark III thread transducer, throughout the country. For miniaturization of your own products he can also give you expert aid in reducing friction and inertia with MPB bearings.

Miracles in Miniaturization

ACTUAL SIZE OF THE MPB BEARINGS IN THREAD TRANSDUCER SHOWN ABOVE

The more than 16,000,000 miniature and instrument bearings produced by MPB have met requirements in over 16,000 different types of applications. Developing bearings to aid in the design and manufacture of smaller, lighter, *better* components has always been a part of MPB service to customers. For details about MPB as a consulting and cooperating force — and for a catalog on MPB bearings, the world's largest line — write to **Lyman Tube and Bearings, Ltd.**, 5420 Pare Street, Montreal. Additional offices: Toronto, London, Winnipeg, Vancouver, and New Glasgow.

MPB *Helps you perform miracles in miniaturization*

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THIS IS GLASS

A BULLETIN OF PRACTICAL NEW IDEAS FROM CORNING

YES, WE HAVE NO GASKETS

Gaskets cause countless problems in sight glasses, people told us.

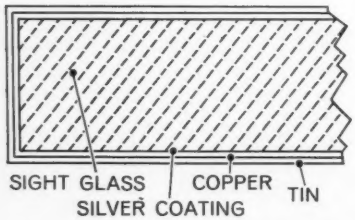
Get rid of the gaskets, we replied.

Show us how, they retorted.

So, we did.

Two ways.

One. We can and do make valve windows wherein the glass is fused directly to the metal without aid of gasket or solder. The result is a one-piece assembly with an heroically hermetic seal rated at 700 psi and bursting strength around 2500 psi.



Two. When it makes sense, we can and do metallize a glass with a base coat of silver, electroplate it with copper, and face it with a coat of tin which accepts soldering to a bezel, which we also can and do do. The finished window is rated to take 15 psi inside or out.

Since we are as versatile as the material we work with, we can pull such tricks as pressing configurations into the windows. We've already done things like bull's-eyes and indentations.

We had another job where we pressed an optical lens into a glass. The focal length of the lens is such that you get a reflection of light back to your eye, except when the unit is full of liquid, in which case you focus on the liquid itself.

Look into our windows whenever you find a gasket a nuisance, whether from temperature or pressure or corrosive environment or any of the many other conditions which tend to make gaskets a nuisance.

You can begin looking by sending the coupon.

ON ENCAPSULATING WITH PYROCERAM® CEMENT

Should you want to lift the thermal ceiling on encapsulated electronic parts as high as 700°C., you'll like what you see when you take a look at our PYROCERAM cement No. 45.

Certain people making coil cores for hot work are finding it almost ridiculously easy to meet such temperature specs while holding performance in all other areas.

The cement is almost completely impervious to vapors and chemically inert. It matches nicely to tungsten, molybdenum and other materials with a coefficient of expansion from 40 to 50 x 10^{-7}/°C.

This same cement can also be used for sealing glass to glass, metal to metal, ceramic to ceramic, or any combination of these materials.

There are two other PYROCERAM cements, both of which have a service temperature of 425°C. No. 89 lends itself well to platinum, vanadium, 50% nickel, and other materials with a coefficient of expansion 80 to 92 x 10^{-7}/°C. No. 95 is for chrome-iron stainless, Sylvania No. 4, and the like with a coefficient of expansion 90 to 110 x 10^{-7}/°C.

People who know say that the applications for this new material are ready to snowball. Perhaps if you send the coupon now, you will be first to use it in your particular field.

VYCOR® GLASSES AS WATER-GETTERS OR PROBE PROTECTORS

Put a piece of porous VYCOR brand glass into a humid environment and it drinks up 25% of its weight in moisture before becoming sated.

This has suggested its use as a substitute for desiccants to a number of people, particularly people who want a getter with unusual rigidity under stress conditions. Say, in a sealed inert-gas gyroscope, for example.

Others have seen in this same 96% silica glass a clean, long-lived semipermeable membrane.

Put one of these tiny tubes of VYCOR glass around a pair of thermocouple wires and you have a device for reading the temperature of working melts of metals or anything else that runs from 2000 to 3000°F.

The tubes will stand up from four to six seconds even under this intense heat, keeping the wires intact long enough to get an accurate reading.

Actually, in practice these tubes are emerging from metal melts marred but still intact two times out of three! Since the glass is 96% pure silica, there's no threat of contamination to the melt even if the tubes should disintegrate.

All of which serves to demonstrate just two of the many amazing properties of the VYCOR brand glasses.

There's more about the various VYCOR glasses with their varied properties and the sizes and shapes we can deliver in a bulletin which is mentioned in the coupon.

CORNING MEANS RESEARCH IN GLASS

CORNING GLASS WORKS, 3911 Crystal St., Corning, N.Y.

☐ Sight Glasses ☐ VYCOR ☐ PYROCERAM Cement

Name..... Title.....

Company.....

Street.....

City..... Zone..... Prov.....

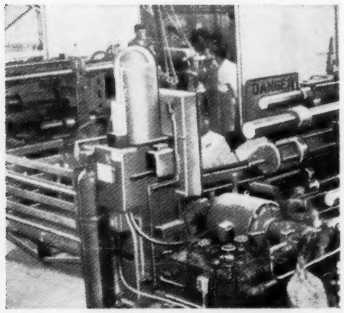
For further information mark No. 122 on Readers' Service Card

New Facilities
for aluminum die-castings

Modern, precision equipment at Hoover assures top quality and fast delivery

New operational methods and facilities enable Hoover to offer a die-casting service that is second to none. This expansion is reflected throughout the entire Casting Division.

From design-engineering to final inspection the emphasis at Hoover is on modern methods, efficient equipment and careful craftsmanship.



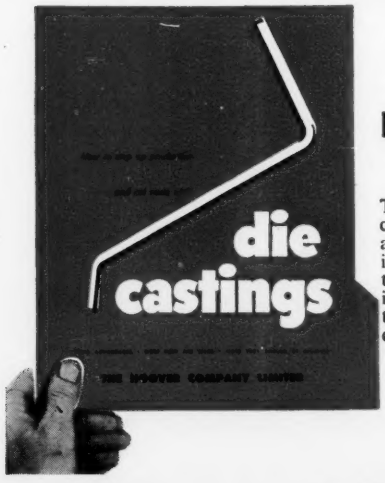
Hoover's die-casting section (above) has machines with ratings up to 600 tons, that can produce aluminum die-castings in quantity from the smallest practical size up to 14″ x 14″.

Trimming, finishing, buffing, machining and painting facilities (partially pictured below) enable Hoover to deliver castings in every state of finish, from "as-cast" to the finest commercial surfaces.

Scientific sampling and thorough testing of finished castings assure consistently high quality and strict adherence to specifications.

When should die-castings be used? There is no simple answer to this question. Generally speaking, die-castings should be used when reduced machining costs, intricate shapes, economy, attractive appearance and durability are factors.

Contact Hoover Die-Casting Division to learn if this precision technique will cut *your* costs.

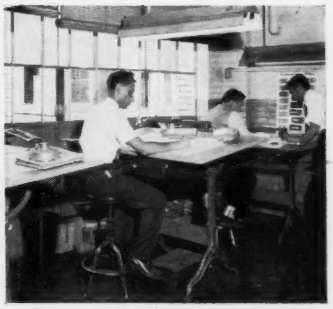


Send for this
FREE
DIE-CASTINGS
HANDBOOK

This informative bulletin on aluminum die-casting will guide you in choosing alloys, and in the design of castings. Hints are included to help you take advantage of the die-casting process. You will also be interested in a detailed picture story that traces the production of die-castings from drawing board to final inspection. Write to

HOOVER
Die-Casting Division,
Hamilton, Ontario

HOOVER
has the
DIE-CASTING know-how



to produce castings at lowest costs

Hoover engineers have a tremendous fund of specialized experience in die-casting. Their knowledge is at your disposal. They welcome the opportunity to discuss your die-casting problems, and to assist in the design of components that will cut your costs and improve your product.

HOOVER
DIE-CASTINGS

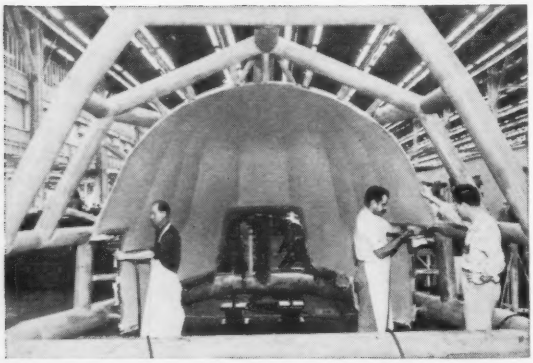
For further information mark No. 141 on Readers' Service Card

1 The tube is a reinforced epoxy housing that protects:
(a) a communications antenna *(b) a radio transmitter*
(c) miniature rockets

2 Its ignition coil, completely embedded in epoxy, is safe from:
(a) moisture *(b) temperature extremes*
(c) shock

Can you pass this test on Epoxy Plastics?

(You'll profit by knowing them better)



3 This airplane construction tool of epoxy-glass cloth:
(a) checks dimensions of fuselage *(b) supports the frame*
(c) is part of the mock-up

4 This tough, strong, pleasure boat hull is made from:
(a) laminated epoxy and glass fiber *(b) epoxy-coated wood*
(c) epoxy-coated metal

5 Their trip to school is safer in a bus with:
(a) epoxy-glass fiber seat frames *(b) an epoxy-sand coated floor*
(c) epoxy-embedded electrical parts

ANSWERS... *to tomorrow's needs are coming from adaptable BAKELITE epoxy plastics.*

1. Check (a). It minimizes weather and electrical interference along our defense communications lines.
2. Pick (a), (b), and (c)—and epoxy won't harm delicate windings, either.
3. (a) Checks dimensions—it's lightweight and extremely accurate.
4. (a) Epoxy-glass laminate—but epoxy coatings are great on other hulls.
5. (b) They won't slip on this floor's tough, gritty surface.

If you have questions—about epoxies and their potential for your business—please ask us. Why not discuss the matter with a Bakelite Technical Representative? Just write or call any of our offices, or write: Union Carbide Canada Limited,

BAKELITE DIVISION
123 Eglinton Avenue East, Toronto 12.

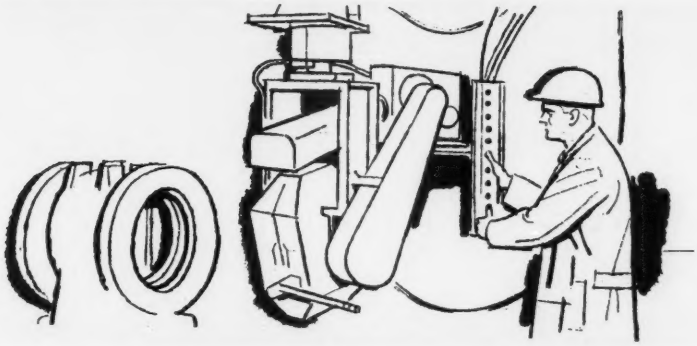
"BAKELITE" & "UNION CARBIDE" are trade marks

UNION CARBIDE

For further information mark No. 106 on Readers' Service Card

Dofasco technicians offer their specialized knowledge of metallurgy, casting design and foundry methods to give you the best castings at the lowest cost.

FROM CONSULTATION



Follow through by Dofasco technicians is your assurance of prompt delivery and of quality. For definite proof of freedom from flaws, your castings can be radiographed on the Cobalt Camera, as an additional service.

TO INSPECTION...

Dofasco Casting Technicians

stress Quality and Service

Dofasco is justly proud of its reputation for prompt delivery — but *quality* is never compromised for *speed.*

Speed and quality go hand in hand, because Dofasco's fully equipped foundry uses the most modern, efficient methods under the guidance of experienced technicians who have your interests at heart.

Whatever your casting needs . . . one or a thousand . . . large or small . . . complex or simple . . . call on Dofasco for quality castings *on schedule.*

DOMINION FOUNDRIES AND STEEL, LIMITED

HAMILTON, CANADA

Ask before you buy, ***"IS IT MADE IN CANADA?"***

For further information mark No. 130 on Readers' Service Card

"YOUR NEXT POLYESTER COMPONENT: mold it or machine it?"

Get an unbiased answer from National because we work either way

Giving the designer facts to help make the *right* design decision faster is perhaps our best "product." Offering the broadest line of plastic materials and services permits us to give impartial help. Take polyester glass mat.

If the facts about configuration, volume, performance, operating conditions and cost point to a *molded* polyester shape, we'll work from scratch—or from your drawings—and deliver 100% usable parts.

If the same facts point to a *machined* part, we'll work the same way . . . and with the same results. In this case National can furnish four standard grades from which to select the one best material. GP-9100-A is our general purpose, medium cost sheet with good electrical and mechanical properties. GP-9104 is also general purpose, but lower cost. GP-9202 is our flame resistant grade and best electrical grade except for arc resistance. GP-9204 is both flame *and* arc resistant, UL-approved for sole support of current carrying parts at temperatures up to 150°C.

One more point. The problems inherent in machining polyester glass laminates have had a tendency to discourage some designers from considering it. We suggest that you bounce this headache out of your production facilities and into ours.

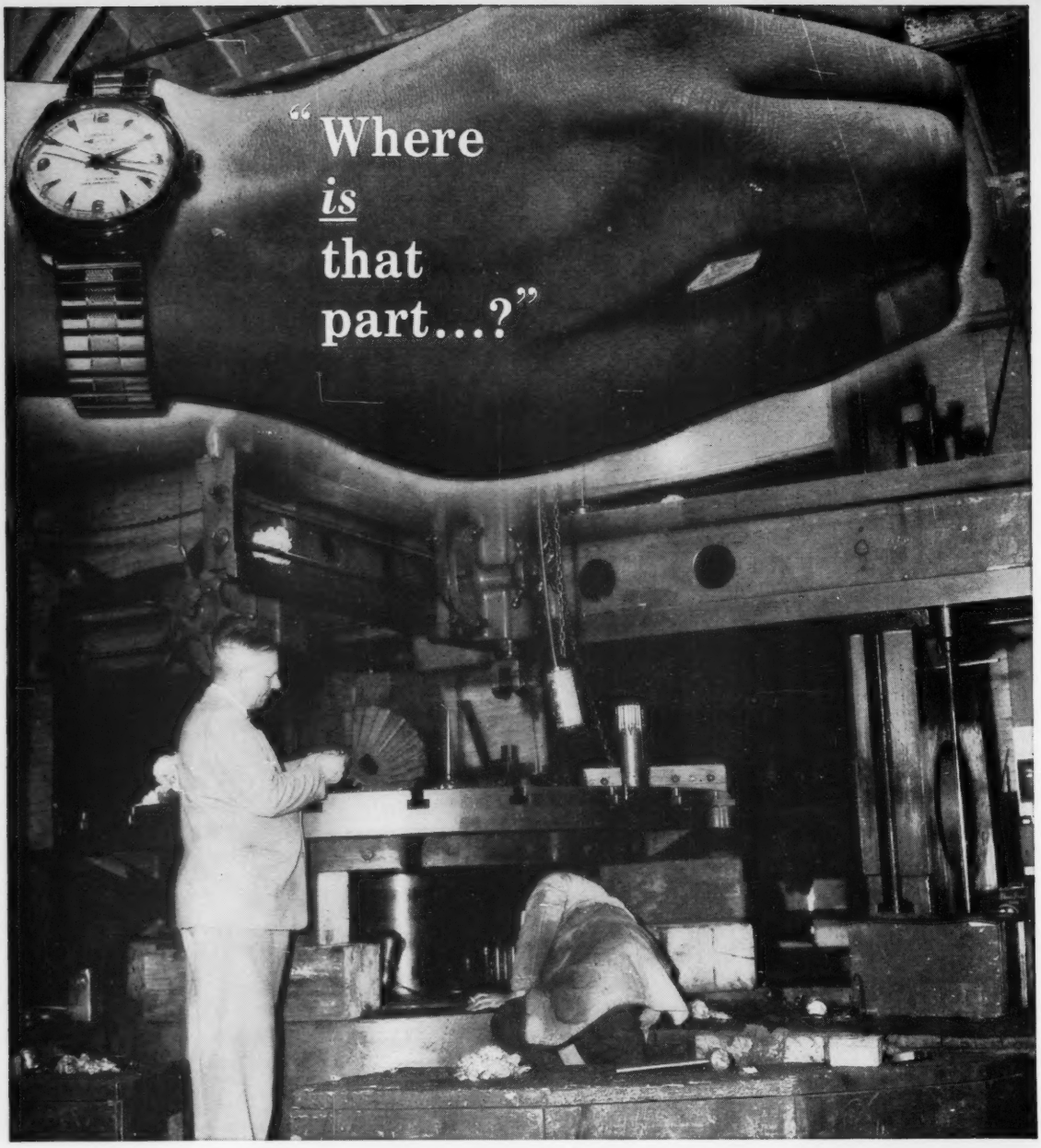
You see, we are interested in *both* your design and machining problems. Your component will be skillfully machined at one of our four complete, "service-located" fabricating facilities.

Send for our Polyester Technical Bulletin 1164. We'll be happy to include, also, data on the full line of National materials — over 100 grades. Write to National Vulcanized Fibre Co., Dept. N-10, Wilmington 99, Delaware.

NATIONAL

FIBRE COMPANY OF CANADA, LTD.

ATLANTIC & HANNA AVENUES, TORONTO
1411 CRESCENT STREET, MONTREAL



how to stop footing the bill for unnecessary downtime

Easily done when you rely on a United Steel "quick-service" warehouse for no-delay-delivery of the replacement Power Transmission equipment you need.

We have huge stocks of standard power transmission equipment, ready to fill your order within minutes of your request. You save on inventory expense *without* sacrificing availability of the units you need for emergency replacement.

We welcome the opportunity to prove that it is "the fastest power transmission equipment service available". Why not make a note of the telephone numbers shown here and stop footing the bill for unnecessary downtime when the next emergency arises?

60-81

United Steel
CORPORATION LIMITED

TORONTO — RO. 2-8242 MONTREAL — WE. 3-4277
KIRKLAND LAKE — 1017 SUDBURY — OS. 4-3053

For further information mark No. 175 on Readers' Service Card

How SHAKEPROOF Protects Your Product's Reputation

Here is the answer to one of industry's toughest problems . . . how to reduce costly inspection rejects and avoid customer complaints due to fastening failure.

Shakeproof engineers have gathered formidable evidence that only one washer locks . . . where others fail! Their findings, just published in the booklet offered at the right, prove that "weight and thickness" don't lock a fastener, and that "spring action" alone isn't locking action.

They have conducted tests with various types of washers commonly used for protection against failure caused by handling and operational vibration. Results show that only Shakeproof Lock Washers retained 100% relative locking efficiency.

Be sure to protect your product's performance and reputation with the one top-quality, top-performance lock washer . . . Specify SHAKEPROOF . . . the *original* toothed lock washer!

Send for this Free Booklet Today—it is filled with factual test data and actual case histories which show how you can be sure of quality at every step in the assembly of your product.

STANDARD SHAKEPROOF LOCK WASHERS INCLUDE:

External Type | Internal Type | Heavy Duty Internal Type | Countersunk Type | External-Internal Type | Pyramidal Type | Dome Type Toothed or Plain Periphery | Dished Type Toothed or Plain Periphery

SHAKEPROOF/FASTEX *"Fastening Headquarters"*®

DIVISION OF CANADA ILLINOIS TOOLS LTD,
67 SCARSDALE ROAD, DON MILLS
TORONTO, ONTARIO

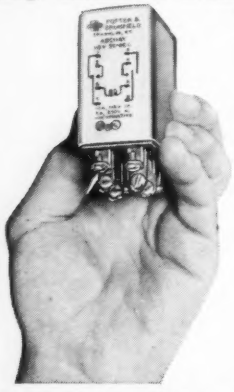
LOOK TO SHAKEPROOF—THE LEADER IN FASTENING

For further information mark No. 111 on Readers' Service Card

appearances are not deceiving

THIS P&B 10-AMP RELAY IS AS RELIABLE AS IT LOOKS

Our AB relay looks rugged . . . and it is. You can specify it for 10 amp switching and confidently expect 100,000 cycles. Yet it is compact, easily mounted, and does not require special handling. Installation is simple, using your preference of screw terminals (adapters), quick connects, or dip soldering.



ABC Series—AB series can be supplied enclosed in sturdy metal dust cover, $1^{31}/_{64}$" x $2^{25}/_{32}$" x $2^{5}/_{32}$".

Designers specify the AB for air conditioners and other products where dependable, continual service is paramount.

These standard AB and ABC relays are listed by Underwriters' Laboratories and Canadian Standards Association:

Type	Arrangements	Type	Arrangements
AB7AY	DPST-NO	ABC7AY	DPST-NO
AB8AY	DPST-NC	ABC8AY	DPST-NC
AB11AY	DPDT	ABC11AY	DPDT

Coil voltages: 6, 12, 24, 115 and 230 volts AC, 50/60 cycle.
Contact rating 10 amps. 115 volts AC or 5 amps, 230 volts AC noninductive.

U/L File E-29244 CSA No. 15734

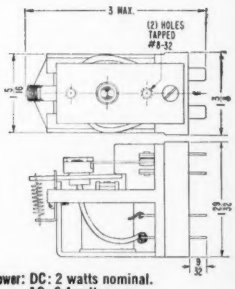
Write for complete data or contact your nearest P&B sales engineer.

AB AND ABC RELAYS ENGINEERING DATA

GENERAL:
Insulation Resistance: 100 megohms minimum.
Life: 3 million cycles (mechanical).
Breakdown Voltage: 1500 volts rms between all elements and ground.
Temperature Range: DC: −55 to +45°C.
AC: −55 to +45°C.
Weight: AB—5 ozs. ABC—7 ozs.
Terminals: Fit ¼" quick-connect terminals, or may be applied to printed circuits using dip soldering. Screw adapters furnished on request.
Enclosure: ABC: Heavy duty dust cover.
Dimensions: $1^{31}/_{64}$" x $2^{25}/_{32}$" x $2^{5}/_{32}$".

CONTACTS:
Arrangements: DPDT
Material: ¼" dia. silver. Other materials available.
Load: 5 amps at 230 volts AC or 10 amps at 115 volts AC noninductive.
10 amps at 28 volts DC.

COIL:
Voltage: DC: 6 to 110 volts.
AC: 6 to 230 volts.



Power: DC: 2 watts nominal.
AC: 6.4 volt-amps.
Resistance: 35,000 ohms max.
Duty: Continuous: DC coils will withstand 6 watts at +25°C.

MOUNTINGS:
AB: Two 8-32 tapped holes on 1¼" centers.
ABC: One 8-32 stud ⅜" long and locating tab.

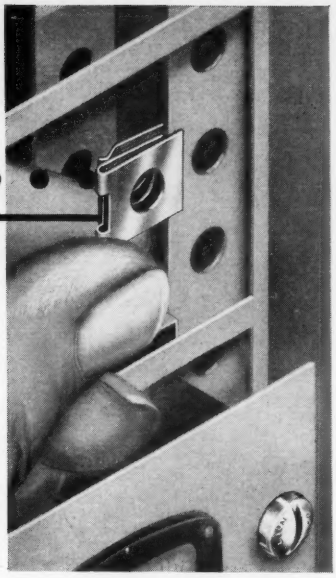
P & B STANDARD RELAYS ARE AVAILABLE AT YOUR LOCAL ELECTRONIC PARTS DISTRIBUTOR

POTTER & BRUMFIELD CANADA LTD.

GUELPH, ONTARIO

For further information mark No. 156 on Readers' Service Card

NEW...



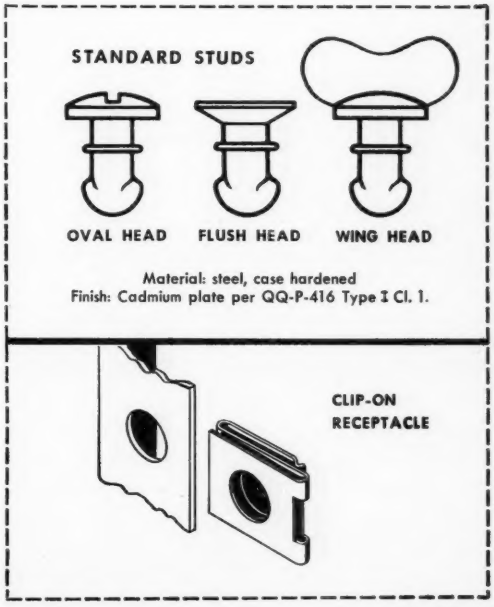
clip-on receptacle cuts ¼ turn fastener installation time by 86%

for LION ¼ *turn* FASTENERS

Riveting and welding are eliminated by the new, time-saving clip-on receptacle that just slips over a hole in your door frame and locks itself in place.

The Lion stud is as easily installed. Slipped through a hole in the panel or door, it is captivated by a split ring retainer. Both the stud and receptacle have a generous "float" to tolerate misalignment of parts.

Operation is fast—¼ turn to lock, ¼ turn to unlock.



FREE! For complete information on this and other fasteners, send for your free copy of Southco Fastener Handbook, Write to your nearest distributor listed below.

Represented in Canada by . . .

METAL AND WOOD FASTENING DEVICES
6302 Papineau Avenue
Montreal 35, Quebec

BLACK BROTHERS, LTD.
1200 Hornby Street
Vancouver, B.C.

WESTAIR SALES CO.
380 Donald Street
Winnipeg 1, Manitoba

METAL AND WOOD FASTENING DEVICES
301 King Street, East,
Toronto, Ontario

SOUTHCO FASTENERS LION

For further information mark No. 165 on Readers' Service Card

STELCO

DROP FORGINGS

information

Send your request for regular mailings of the Stelco bulletin "Drop Forgings Information".

DROP FORGED by STELCO

. . . to meet high standards for high voltage!

50 STELCO YEARS OF PROGRESS 1910-1960

This drop forged steel Dead End, a component in a tubular compression dead end assembly used with high tension electrical lines, must provide strength and dependable service over long periods of time.

Forgings are stronger than the same parts machined or cast from similar steels. At Stelco metallurgical control guarantees quality, and modern drop forging techniques produce complicated shapes to close tolerances to reduce costly machining. *Drop forged parts are competitively priced* . . . contact Stelco at Gananoque or any Stelco Sales Office for additional information.

Please quote reference No. 660 when enquiring

THE STEEL COMPANY OF CANADA, LIMITED

Drop Forge Division, Gananoque, Ontario

Sales Offices: Halifax, Saint John, Montreal, Ottawa, Toronto, Hamilton, London, Windsor, Sudbury, Winnipeg, Edmonton, Calgary, Vancouver. J. C. Pratt & Co. Limited, St. John's, Newfoundland.

60273-B

For further information mark No. 167 on Readers' Service Card

AVAILABLE NOW FROM THE PLASTICS DIVISION OF C-I-L

POLYTHENE Resins and Compounds for flexible pipe, housewares, films, bottles, wire and cable insulation, paper-coating, etc. Stocked at Montreal, Toronto, Edmonton, Vancouver.

"PERSPEX" Acrylic Sheet for signs, lighting diffusers, displays and glazing. Stocked in a wide range of colours, corrugations and patterns at Montreal, Toronto, Winnipeg and Vancouver.

"MOULDRITE" Urea Formaldehyde Compound for colourful closures, buttons, radio cabinets, wiring devices and appliance hardware. Stocked at Montreal and Toronto.

"DIAKON" Acrylic Resins and Compounds for lenses, decorative mouldings and brush backs.

"FLUON" Polytetrafluoroethylene (P.T.F.E.) has exceptional resistance to adhesion and chemical attack at working temperatures up to 500°F. Available as resins for moulding; coagulated dispersions for extrusion; aqueous dispersions, primers and finishes for coatings.

"CORVIC" Polyvinyl Chloride and Co-Polymer Resins for wire insulation, fabric coating, floor tile, film, sheeting, foams, slush moulding, dip-coating and phonograph records.

"Pro-fax" Polypropylene resins for filaments for rope and textiles, film, housewares, automotive and appliance parts and hospital utensils.

"PENTON" Chlorinated Polyether for corrosion-resistant valves, tank linings and pipe.

"WELVIC" Polyvinyl Chloride Compounds for rigid pipe, wire-coating, profile extrusions, phonograph records and mouldings.

"FLOVIC" Polyvinyl Chloride-Acetate Co-Polymer Sheet and Foil for vacuum-formed displays, packaging, lighting diffusers, printing stock, trays and tote boxes.

"DARVIC" Polyvinyl Chloride Rigid Sheet for fume ducting, corrosion-proof tanks and linings, displays, signs and colour laminated engraving stock. Stocked at Montreal, Toronto and Vancouver in a range of colours.

"HI-FAX" High Density Polyethylene Resins and Compounds for blown bottles and toys, pipe, jacketing of metal pipe, wire insulation and housewares. Stocked at Montreal and Toronto.

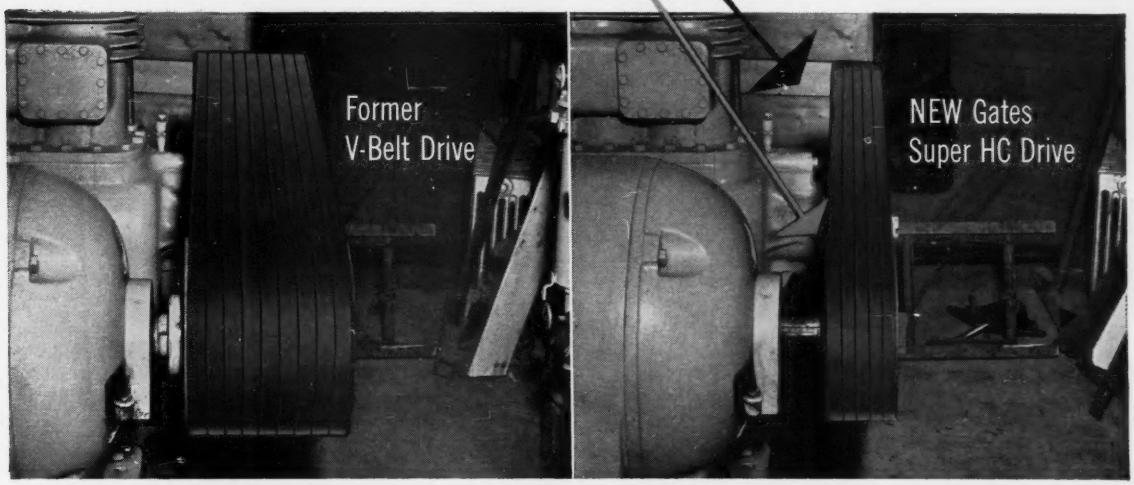
CANADIAN INDUSTRIES LIMITED

C-I-L

219 Duckworth St., St. John's, Nfld. | 45 Commission St., Halifax, N.S. | 2055 Peel St., Montreal, Que. | 130 Bloor St. W., Toronto, Ont. | 30 Midland St., Winnipeg, Man. | P.O. Box 428, Edmonton, Alta. | 1155 W. Georgia St., Vancouver, B.C.

For further information mark No. 116 on Readers' Service Card

Same machine...same horsepower...new compact drive



New high capacity Gates V-Belt cuts drive costs as much as 20%

Saves up to 50% in drive space!

The Gates Super HC V-Belt is a completely new concept in V-belt design . . . fully proved by over 5 years of extensive field testing . . . a product of Gates *Specialized* Research.

Because of the exclusive design features of the Gates Super HC V-Belt, it transmits up to 3 times the horsepower of standard V-belts in the same space. As a result, sheave diameters and sheave widths can be reduced as much as 50%, and center distances can be reduced 20% and more.

Moreover, with the Gates Super HC V-Belt drive, your cost is up to 20% less than for other V-belt drives of the same horsepower capacity.

All this means that by using the Gates Super HC V-Belt, you can have the lowest cost, most compact, lightest-weight multiple V-belt drive you can put on any machine.

Exclusive design features include:

precisely engineered arched top, concave sidewalls, Flex-Weave cover, super strength tensile construction.

World's Largest Maker of V-Belts

Gates

Gates Rubber of Canada Ltd.

Brantford, Ontario

X-932-E

Gates Super HC V-Belt Drives

For further information mark No. 138 on Readers' Service Card

A GeMex APPLICATION

INDUSTRIAL TOTE BOXES

For greater ECONOMY AND EFFICIENCY IN material handling operations

Since the dawn of civilization, man has used baskets and boxes to tote and carry his many possessions.

Now at last, a new man-made material provides for a really efficient product.

The New GeMex Tote Boxes specially designed for easy carrying, solid stacking and nesting can increase the efficiency of your material handling operations.

Stronger, lighter, and requiring no maintenance, GeMex Tote Boxes are lower in cost, and yet are practically indestructible.

Descriptive literature and sample of the material are available on request . . .

plastic experts for over 50 years

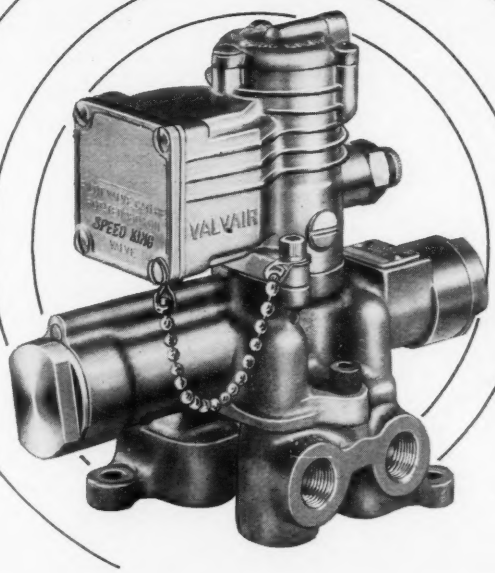
G.M. PLASTIC CORPORATION

G.M. PLASTIC CORPORATION

P.O. Box 548 GRANBY, P.Q. FRontenac 2-5457

For further information mark No. 139 on Readers' Service Card

No coil burnout with SPEED KING®



...pilot operated control valves

• Built to JIC standards • interchangeable pilots • choice of mounting types, optional features • ac or dc, any voltage • ¼ to 1 in. NPT

SPEED KING solenoid pilot coils, potted in molded resin, are unconditionally guaranteed against coil burnout for the life of the valve! And, Speed King pilots are totally enclosed, and sealed against entrance of dirt or moisture . . . valves are fully air-operated for speed and dependability . . . feature a hard-chrome plated stainless steel plunger floating in O-rings, to eliminate wear-producing metal-to-metal contact.

For multi-million cycle dependability, specify Valvair® SPEED KING control valves.

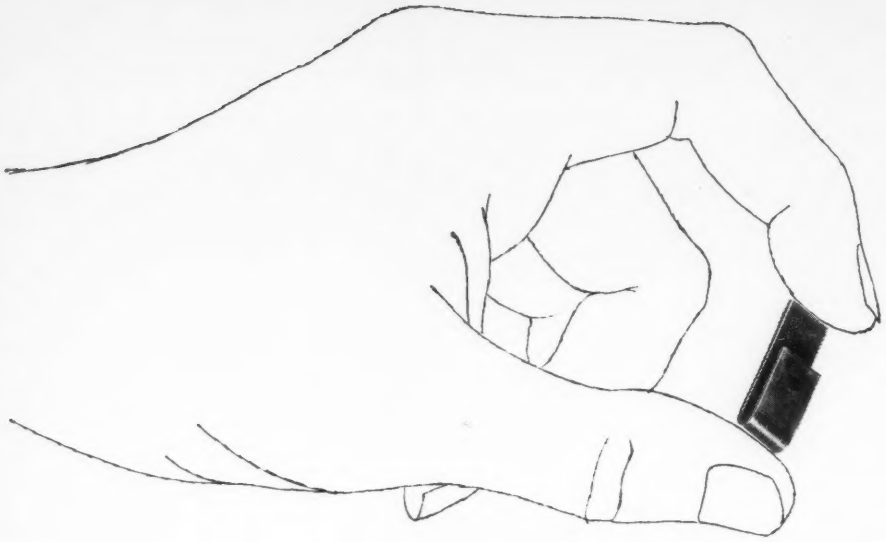
Write for free Bulletin SK-100. Address: Bellows-Valvair Ltd., Toronto 18, Ontario, Dept. DE-1160.

Bellows-Valvair, Ltd.

TORONTO 18, CANADA

8111-1

For further information mark No. 107 on Readers' Service Card



IMPORTANCE COMES IN MANY SIZES

This stamping is one of thousands developed and manufactured by the engineering team of Wallace Barnes. Although it is small, it has an important part to play in the end product. It must be exactly right in design, temper, and performance characteristics to function positively and reliably in the product in which it is used.

To be sure *your* stampings are exactly right, get the benefit of Wallace Barnes' 500 man-years of experience in the specialized field of small stampings and springs.

Modern tool-making and production facilities are your assurance that each and every stamping will meet your specifications.

From creative engineering to prompt delivery . . . you can depend on Wallace Barnes.

Send for your FREE copy of "Pocket Guide to Springs and Other Things". A pictorial guide of our products and services.

The Wallace Barnes Company Ltd.

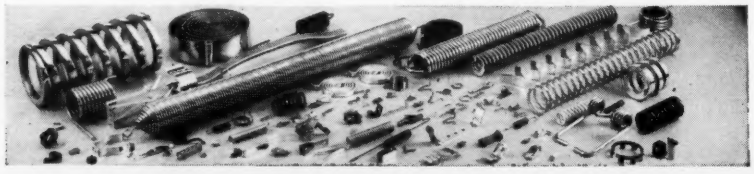
Subsidiary of

Associated Spring Corporation

Hamilton, Ontario

Pointe Claire, Que.

Sales Agent: E. A. Tipping Sales Ltd., Winnipeg—Vancouver (Richmond)



64-230

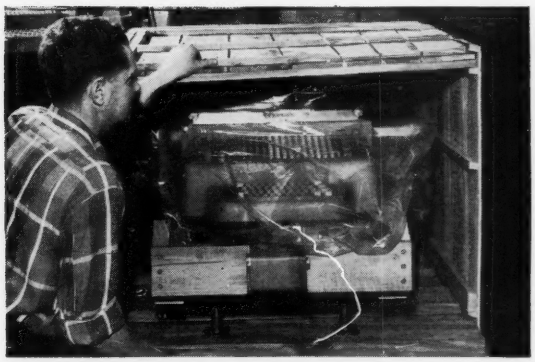
For further information mark No. 179 on Readers' Service Card

1 This bottle molded of tough polyethylene carries:
(a) alkali *(b) acid for dry-shipped batteries*
(c) water

2 *Polyethylene pipe irrigates 50-acre park because:*
(a) won't rust or corrode *(b) easy to install*
(c) it's lightweight

Can you pass this test on Polyethylene Plastics?

(You'll profit by knowing them better)



3 *Polyethylene film protects expensive business machine in transit against:*
(a) dust *(b) moisture* *(c) high packing costs*

4 This muffin box is coated *inside* with polyethylene to:
(a) make it moisture-proof *(b) prevent grease staining*
(c) please the housewife

5 The familiar garbage can—a product polyethylene modernized:
(a) three ways *(b) four ways*
(c) five ways

ANSWERS... *to an increasing range of needs are found in* UNION CARBIDE *Polyethylene.*

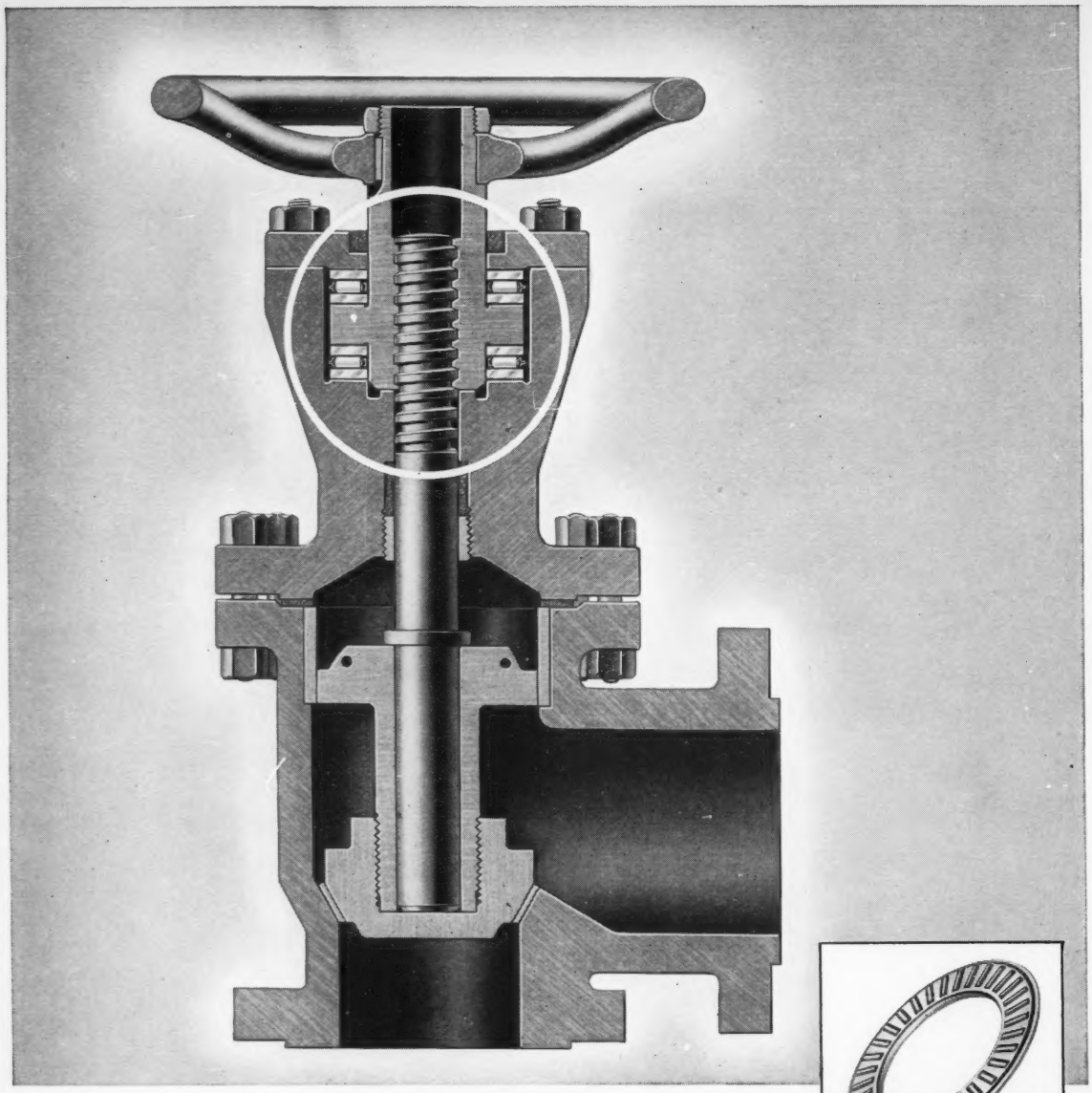
1. (b) Battery acid—unbreakable polyethylene bottles are inert to almost all chemicals.
2. Check (a), (b) and (c)—plus no scaling; unharmed by freezing.
3. Check (a), (b) and (c). Film eliminates expensive air-tight wooden shipping crates.
4. (a) and (b) are right—so (c) is a natural.
5. (c) Five important ways—non denting, light weight, integral color, less noise, and resistance to chemicals.

If you have questions—about polyethylene and its potential for your business—please ask us. Just write or call any of our offices or write Union Carbide Canada Limited, Chemicals & Plastics Division, 123 Eglinton Ave. East, Toronto 12, Canada.

UNION CARBIDE POLYETHYLENE

UNION CARBIDE is a trade mark

For further information mark No. 120 on Readers' Service Card



Compact valve design, easier operation with Torrington Needle Thrust Bearings

High thrust capacity, thin cross section and low unit cost have made Torrington Needle Thrust Bearings a natural choice for top valve performance. With Torrington Needle Thrust Bearings, only a fraction of the normal closing effort is needed. This puts less strain on the valve... means smoother, more reliable operation. Lifetime pregreasing insures peak efficiency over years of extra service life.

Torrington Needle Thrust Bearings are exceptionally compact. They provide an assembled height far less than any other type of thrust bearing. They may be run directly on adjacent hardened and ground surfaces, or, as shown above, on standard Torrington thrust races.

If you make gate valves, globe valves, angle valves—in fact, any valve closed on a threaded stem—you'll find it pays to investigate the top efficiency of Torrington Needle Thrust Bearings. Call or write Torrington—maker of every basic type of anti-friction bearing.

Torrington Needle Thrust Bearing

Torrington Thrust Race

progress through precision **TORRINGTON BEARINGS**

THE TORRINGTON COMPANY, LTD. 925 Millwood Road, Toronto 2, Ontario

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DU PONT OF CANADA
INTRODUCES A DISTINGUISHED NEW NAME IN CANADIAN PLASTICS

sclair

Linear polyethylene injection moulding powder for HOUSEWARES, TOYS, SPORTSWARES, MOULDED PACKAGES, AUTOMOTIVE PARTS

With its ultra-modern St. Clair River Works near Sarnia now on stream in some lines, Du Pont of Canada is proud to offer the unusual qualities of SCLAIR polyethylene to Canadian manufacturers. The result of more than five years intensive research and development, Canadian-made SCLAIR is specifically designed to meet Canadian conditions.

"SCLAIR" SETS THE STAGE FOR YOUR NEW OPPORTUNITIES

Designed for injection moulding of articles ranging from mixing bowls to toy trains, from hockey shin pads to scuff plates for automobiles, SCLAIR polyethylene makes products that are tougher and stronger. SCLAIR gives high product yields and produces a wide range of lively, high-gloss colours, as well as offering a number of important moulding advantages. Whether it's to reduce the manufacturing cost of a present line or developing new ones, SCLAIR offers you exceptional qualities priced for every-day use.

THINK CANADIAN — TRY CANADIAN — BUY CANADIAN

It costs you no more to buy Canadian. Joining the distinguished line of new products introduced by Du Pont of Canada, SCLAIR is made for and priced for the Canadian market. Moulders and product designers are being invited to use Du Pont's plastic sales service laboratory at Kingston, Ontario, and your enquiries about this revolutionary Canadian-developed material will receive prompt attention.

Du Pont of Canada Limited, Room 412, P.O. Box 660, Montreal.

"Sclair" is Du Pont of Canada's trade mark for its polyolefin resins.

DU PONT CANADA

BETTER THINGS FOR BETTER LIVING ... *THROUGH CHEMISTRY*

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Design Notes on Fluid Power

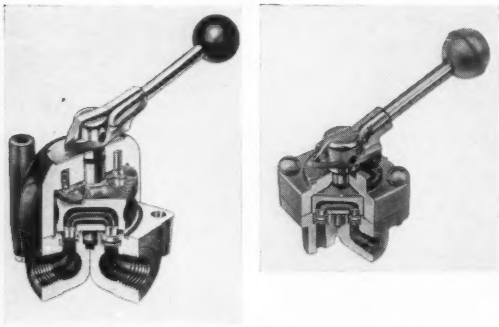
RELEASE NO. 3: LEAKAGE IN FLUID POWER SYSTEMS

Many of you will recall the dramatic and expensive fire, which completely gutted General Motors' Transmission plant at Livonia a few years ago. It was generally agreed at the post-mortem that the rapid and unexpected spread of the fire was due to hydraulic oil which had impregnated the wood-block floor. G.M. now specifies leakproof valves and fittings in all equipment, and will not tolerate leaks. Frankly there is no more reason to let hydraulic oil leak onto the plant floor than onto the living-room rug.

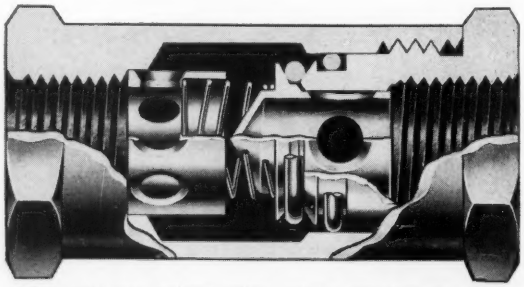
Apart from external leaks, which everyone can see, there are also internal leaks. All spool-type valves, which depend for sealing on a fit between the spool and the body will leak more or less, depending on manufacturing tolerance; the more they are used, the more they wear, and the more they leak. A good quality ¾" valve, when new, might leak 20 to 30 cubic inches per minute at 3,000 psi; if you buy a cheap one, you're buying more leakage. Don't forget to take leakage into consideration when you design your system. Another hidden leak is across split ring seals in heavy-duty cylinders. If you don't want your cylinders to creep, specify leakproof seals. Ball check valves seal well at high pressure, but leak at low pressure. Worn relief valves are serious offenders, and cause slowdown and overheating.

In pneumatic systems, the leaks do not mess up the floor, nor create a fire hazard, but they still cost money. Don't buy a new larger compressor before having eliminated all your air leaks. (If you mark this ad number on the reader's service card, we'll send you a poster card for your bulletin board, entitled "Report Air Leaks: Air Costs Money".) The point is: leakage is both wasteful and unnecessary. One cubic foot per minute of air at 100 psi represents about ¼ H.P. One gallon per minute of oil at 1,500 psi. represents 1 H.P.

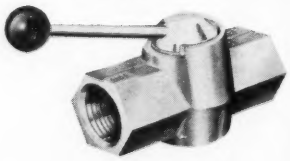
So help the poor maintenance man: specify valves and fittings that don't leak, internally or externally; select pumps with high volumetric efficiency, so that most of the oil will work for you instead of against you. Always design for ease of maintenance. Your company and you will reap dividends.

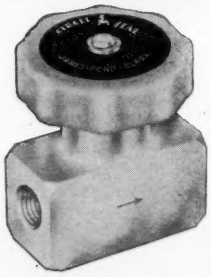


BARKSDALE valves, because of their "shear-seal" design, are true **NO-LEAKAGE** valves. Left, 6100 series four-way for 3000 psi. Right, 5000 series for 250 psi pneumatic and hydraulic. Also available for water and other services, to 10,000 psi.



CIRCLE SEAL zero leakage valves, making ingenious use of the floating O-ring seal. Available for most liquids and gases. Above, 200 series check valve. Below, left, low pressure, low torque plug valve and right, 6000 psi shut-off, dead tight.





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ROUSSEAU CONTROLS LTD.

640 Decourcelle St., Montreal 30, P.Q.
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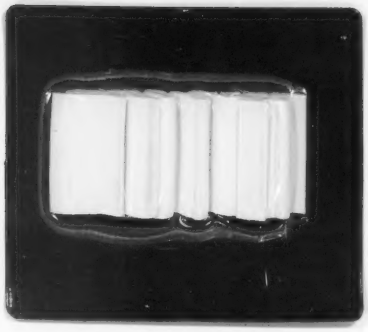
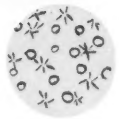


TEST the unique properties of this sample

1 

BOILING: *Boil this sample in water indefinitely. Notice that there is no change in appearance, elasticity, colour or strength. This ability of Silastic to withstand moist heat and low pressure steam makes it an ideal gasketing material for steam irons, washing machines and dish washers.*

2 

FREEZING: *Now freeze it in the ice cube tray of your refrigerator, take out the cube and break out the sample. Even after weeks of freezing it is just as rubbery and resilient as ever. Silastic at low temperatures remains pliable and elastic and is an ideal rubber material for aircraft seals, and innumerable extruded and moulded parts destined for cold exposed areas.*

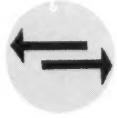
3 

BAKING: *For a really tough test leave the sample in a 500°F oven for hours. Again the Silastic is unaffected. This characteristic makes it an ideal material for oven door gaskets, hot air ducts, belt coverings and electric frying pan gaskets. You may have a Silastic gasket on your oven.*

4 

HEAT CONDUCTING: *Place the sample on a burning light bulb and hold it with the end of your finger. In a short time you will feel the heat through the Silastic. This demonstrates its excellent thermal conductivity. This ability of Silastic to conduct heat quickly is very useful in motor insulation, wire coverings and all types of electrical equipment.*

Good thermal conductivity means cooler equipment, smaller equipment and more efficient equipment. It is also important in totally encapsulated parts where the Silastic protection does not mean a hotter operating part.

5 

PARTING: *Try to stick a piece of pressure-sensitive tape to this sample. Nothing sticks to Silastic (except of course Silastic adhesives). This characteristic is most important wherever there are release problems. Silastic is used for roll coverings and belts handling sticky materials. Silastic gaskets or seals are easily removed.*

6 

BURNING: *If you hold a match to this sample IT WILL BURN. The interesting thing is the ash — it is silica. When Silastic burns, it does not carbonize, but remains an excellent insulator. This is very important in all electrical applications. Even when the insulation burns the ash continues to insulate. Silastic will never char and conduct.*

SILASTIC

DOW CORNING FIRST IN SILICONES

from one extreme to the other
is the story of Silastic Silicone Rubber
HERE ARE SOME

applications

There are many other tests that Silastic passes easily but the nature of these tests is such that we could not ask you to try them. One example is solvent resistance. There are Silastic stocks with excellent resistance to gasoline and aromatic solvents that are used in the chemical, petroleum and automotive industries. Another is resistance to ozone and corona, most important in the electrical industry. Another is resistance to weathering: there are innumerable outdoor applications for seals, gaskets, extrusions and wire coverings where only Silastic will last indefinitely. Another is toxicity. Silastic is non-toxic — so non-toxic that artificial heart valves that have to last a lifetime are made from it. There are many other medical, pharmaceutical, and food applications. Silastic is of course unaffected by moisture. Open-frame Silastic insulated motors are regularly cleaned with a hose — while running. Silastic is also resistant to: abrasion, corrosive atmospheres, chemicals and radiation. Take our word for it — there are Silastic stocks that are unaffected by most or all of these tests. Silastic may be moulded, dispersion coated, extruded, coated on wire or calendered. It can be fabricated as readily as organic rubber and can of course be pigmented to almost any desired colour.

Possibly the greatest challenge to industry are the Dow Corning Silastic RTV's. These are liquid rubbers that vulcanize at room temperature — and the vulcanizing time can be as brief as 2 minutes or as long as 24 hours. When it sets up, Silastic RTV has the same basic characteristics as the stocks discussed above. Delicate electronic components can be dipped in it. It can be used to pot whole assemblies. It is the most durable caulking material we have ever seen. You can use it to make your own gaskets. You can also use it to make moulds or copies of intricate shapes. It will reproduce detail as fine as fingerprints. A new use for Silastic RTV is the encapsulation of random-wound motor coils to provide protection from moisture, water, dirt, vibration, abrasives, chemicals and thermal and mechanical shock. Should a Silastic-protected part or component ever need service the rubber can be cut, the repair made and the Silastic RTV resealed with more self-curing Silastic RTV.

Silastic costs more pound for pound than many other materials. However, the cost of any material is not always what it seems. To find the real price of any item, you have to relate its cost to how well it does the job. In other words you just can't equate price-per-pound to performance. So you're better off to design 'through a problem' with Silastic, than around it with other materials.

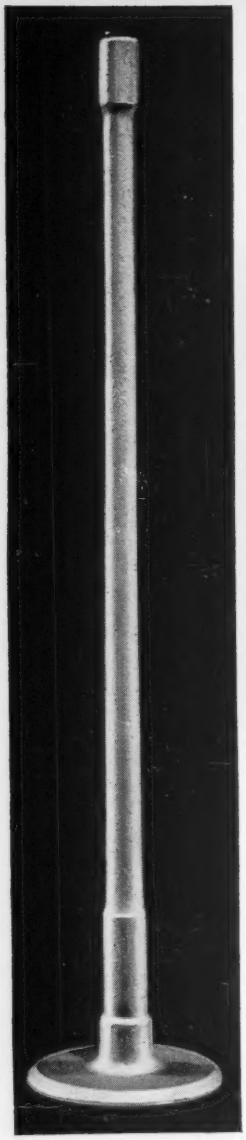
You might well say "O.K., Silastic is fine for special purpose applications where premium materials are needed and premium prices can be afforded, but where are the across-the-board applications in ordinary products?" Daily, Silastic in its many forms is moving out of its specialized areas of application to find growing acceptance in industry. Its characteristics mean reliability of a new order, thus long-term economy through reduced or eliminated maintenance and repair of industrial and consumer products.

If you are interested in Silastic silicone rubber we will gladly supply you with complete technical data and samples. Dow Corning does not manufacture parts of Silastic or Silastic coated wire, but we can give you the names of Silastic fabricators or wire manufacturers in your area. We do stock and supply; direct to you, all types of Silastic RTV silicone rubber. For information contact any of our branch offices.

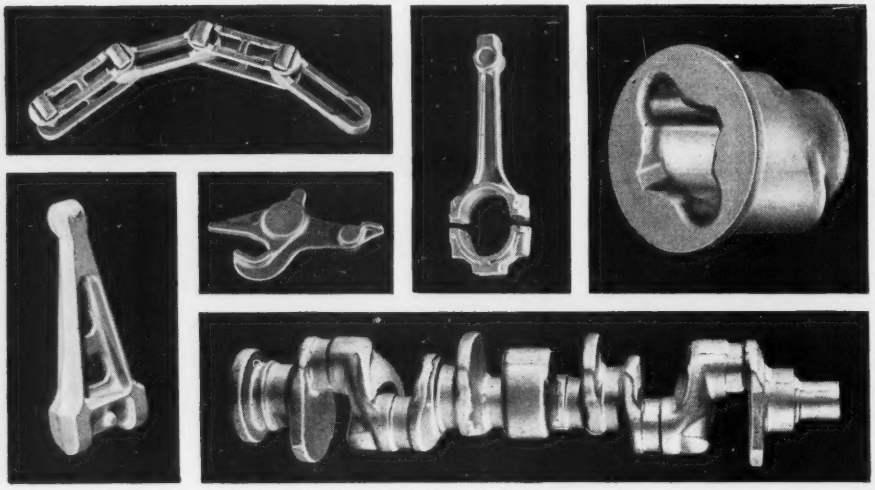
first in silicones

Dow Corning Silicones LIMITED

VANCOUVER TORONTO MONTREAL



The many shapes of FORGING



The many shapes of QUALITY

The shape may be simple or complex. Perhaps you're designing a shaft, rod, lever, arm, fork, gear, bar, bracket or spindle. It may weigh an ounce or 300 lbs. Your quantity may be 15 or 150,000.

These are forging "variables," and give you some hint of the scope and flexibility of Dominion Forge. But regardless of shape, size or quantity, you're sure to find each Dominion forged part has quality in common with the other. From top-quality Canadian metals, Dominion forges exceptionally strong, lightweight, uniform parts... with outstanding resistance to impact and fatigue. Whatever the part... if maximum strength-weight ratio is a must, design it as a forging. If maximum quality and prompt service are musts, get your forgings from Dominion Forge... one of North America's *great* forging organizations. To insure complete satisfaction, call in a Dominion forging engineer during the earliest stages of design. He's a forging expert, and can save you time and expense.

WHEN IT'S A VITAL PART... DESIGN IT TO BE FORGED

FREE DATA BOOK, fully illustrated, will be an informative and helpful reference source to any user or prospective user of forgings. Full of facts about forgings, together with a description of Dominion facilities and services. Write today, on your company's letterhead, for your copy.

DOMINION FORGE LIMITED

MEMBER: DROP FORGING ASSOCIATION

2480 Seminole Street, Windsor, Ontario, Canada
Telephone: CLearwater 4-7545. Cable Address: Domforge

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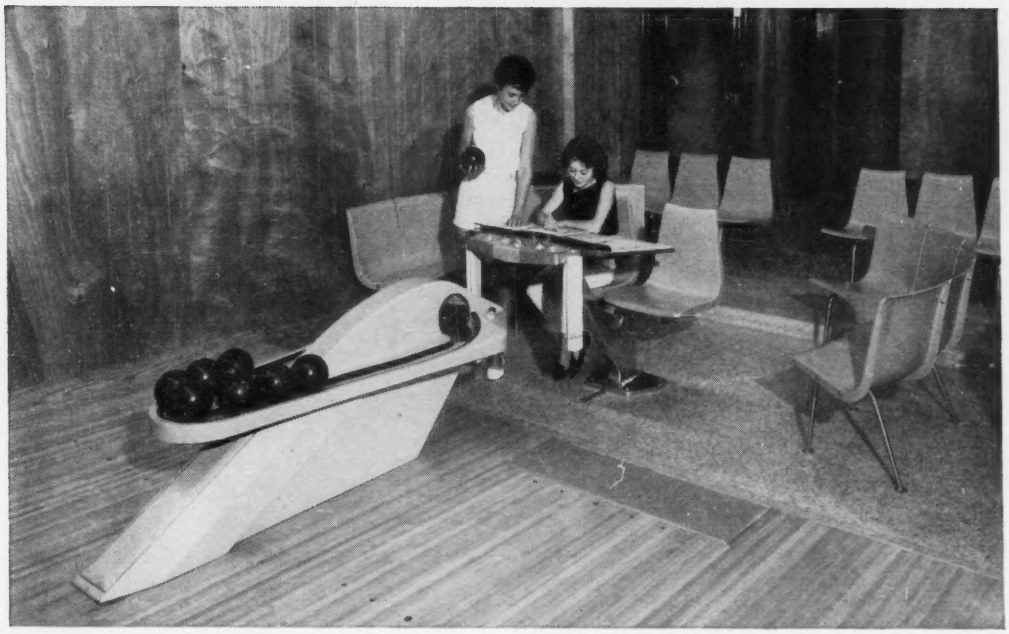
VIBRIN

molds better products more economically!



Have yourself a ball... It's VIBRIN!

This superbly styled line of equipment was especially designed by Sid Bersudsky Associates for Double Diamond Billiard & Bowling Supply Co. And everything: the seats, benches, score card table tops, and the 'below-floor' ball returns, are formed of VIBRIN polyester resins . . . by Protective Plastics Ltd. of Toronto.

Everyday, VIBRIN is improving on metal, wood and other materials, in a multitude of products which include watercraft, aircraft, locomotive parts, traffic signs, truck bodies, and even sectional swimming pools.

You'll like VIBRIN's wax-like obedience to pressure which makes it so easy to mold, and its uncompromising loyalty to shape.

Naugatuck technical representatives are at your service, and the facilities of our development laboratories are available to help you evaluate VIBRIN. Simply contact Naugatuck Chemicals at Elmira, Ont., or branches in Montreal, Toronto, Winnipeg or Vancouver.

VIBRIN IS DISTRIBUTED BY:

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MONTREAL: WALDOR ENTERPRISES LIMITED
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N C

NAUGATUCK CHEMICALS

DIVISION OF DOMINION RUBBER COMPANY LIMITED

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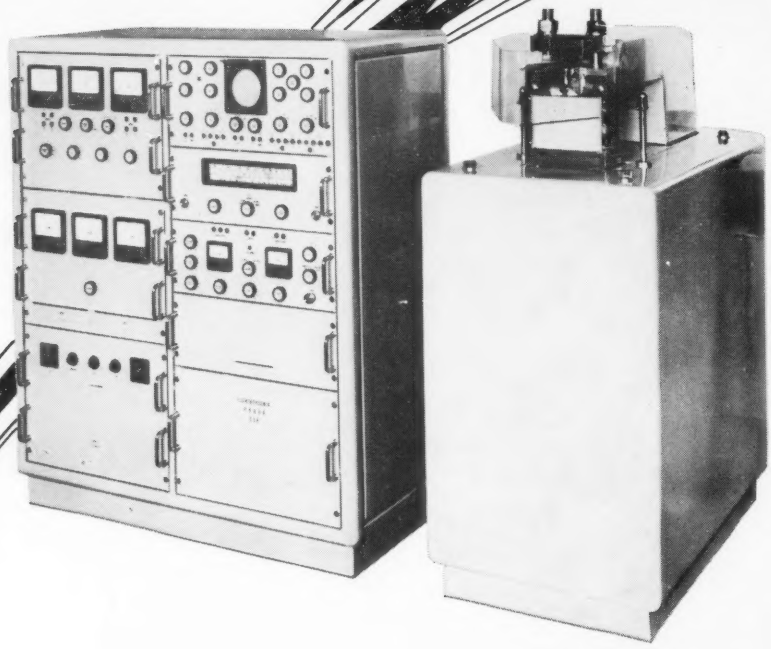
TURBO 4
Apparatus



A self-oscillating vibration apparatus designed for fatigue testing of mechanical components and turbine blades.

EXPORTED by

KOVO

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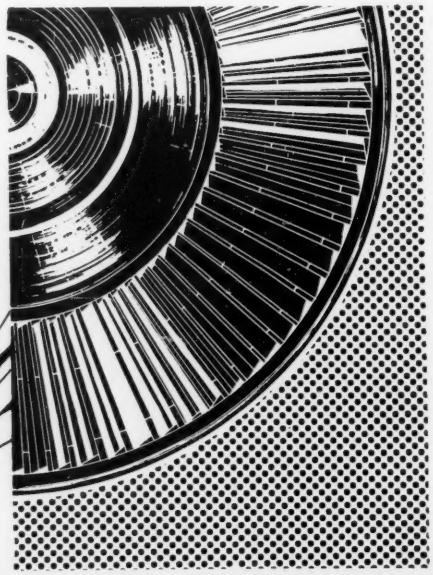

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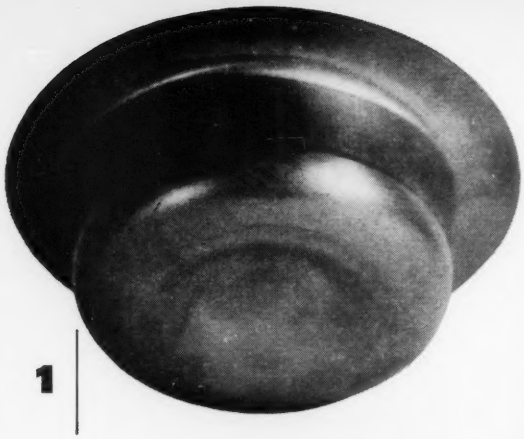

1

2

3

4

FOR QUALITY SINK STRAINER BODIES ...

GALT MALLEABLE USES NORANDA BRASS

Galt Malleable Iron Co. Ltd. uses Noranda Yellow Brass for these sink strainer bodies because it is exceedingly ductile and possesses the fine mechanical properties necessary for ease of fabrication and obtaining an attractive finish. The four stages shown here provide a good example of the suitability of Noranda brass and copper alloys for products made by drawing, spinning, stamping and cupping.
Call your nearest Noranda Sales Office, we will be glad to assist in the selection of an alloy with the correct grain size and temper to suit your particular production requirements which may help you obtain quality in volume at a competitive cost.

THE KEY TO THE BEST IN METALS

Noranda Copper and Brass Limited

SALES OFFICES: Montreal • Toronto • London • Edmonton • Vancouver

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Meet Gilbert MacAinsh of Simcoe, Ontario

Skilled hands and modern machines team up in this final assembly operation for single-width Morse #100 chain and all other types.

THE MAN FROM MORSE

WHO MAKES THE ROLLER CHAIN

THAT DRIVES THE MACHINERY

IN MUCH OF CANADA'S INDUSTRY

Gilbert MacAinsh works at Morse Chain of Canada. He makes Morse Roller Chain for use on industrial equipment ranging from farm implements and oil drilling to construction and materials handling.

And it's important to know that at Morse, high quality and precision manufacturing of *all* Morse products are the "order of the day." Perhaps that's why Morse Automotive Timing Chain is specified as original equipment by every Canadian automobile manufacturer.

Whatever your power transmission needs—chain, sprockets, "Timing"® belts, speed reducers, couplings or clutches—your Morse distributor is the man to talk to. He's listed in the Classified Directory under "Power Transmission." Or for information, write or call: MORSE CHAIN OF CANADA, LTD. A BORG-WARNER INDUSTRY—SIMCOE, ONTARIO. Phone GArfield 6-4960.

BUY CANADIAN

MORSE B-W

A BORG-WARNER INDUSTRY

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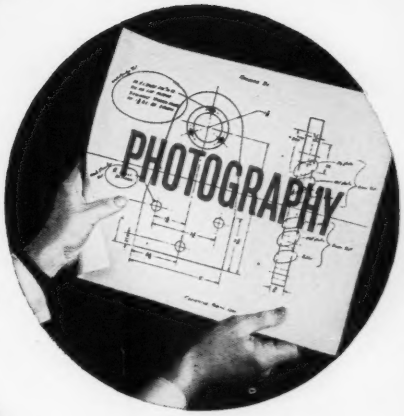
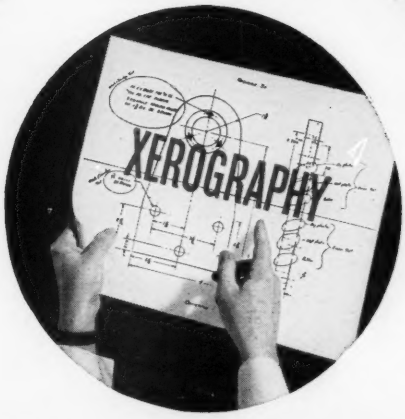
Use any reproduction process . . .

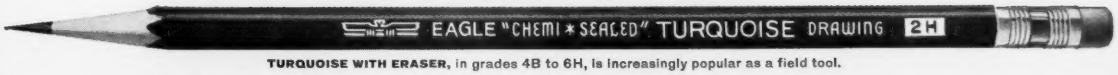




Your drawings reproduce sharper, clearer with Eagle Turquoise

TURQUOISE LEAD HOLDERS hold any TURQUOISE lead (5B to 9H).

TURQUOISE DRAWING PENCILS are made in 17 degrees, 6B to 9H.



TURQUOISE WITH ERASER, in grades 4B to 6H, is increasingly popular as a field tool.

Whatever the process, you'll get sharper, clearer prints if you use an Eagle TURQUOISE. Lines are more opaque and also blacker—because the graphite in TURQUOISE is finer-ground with denser-packed particles.

Get smoother, neater drafting, too! TURQUOISE glides effortlessly, evenly over paper, cloth, vellum, "Mylar"® And uniform grading means consistent peak performance.

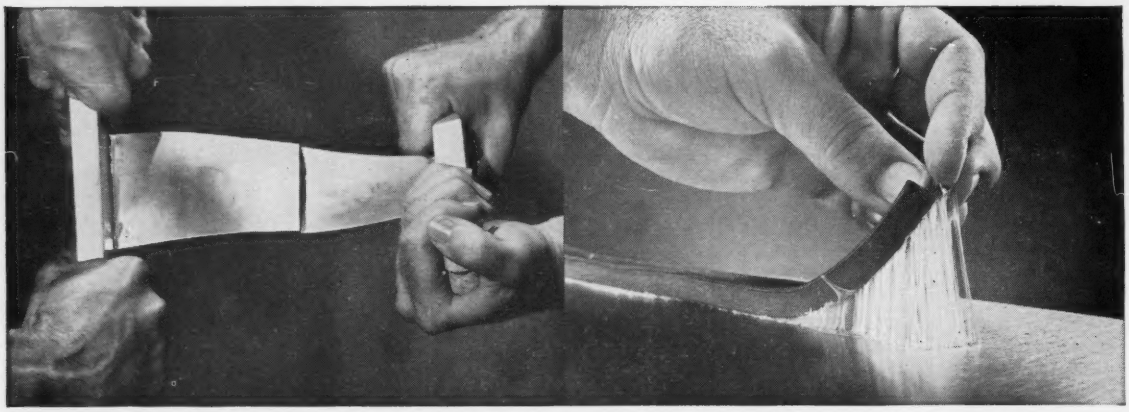
So, no matter what you draw on, how you reproduce it, use Eagle TURQUOISE for superior results every time!

EAGLE

WANT A FREE SAMPLE? Write for a TURQUOISE pencil or lead, in the degree you'd like to test on your favourite drafting material. Eagle Pencil Company of Canada Ltd., 217 Bay St., Toronto 1.

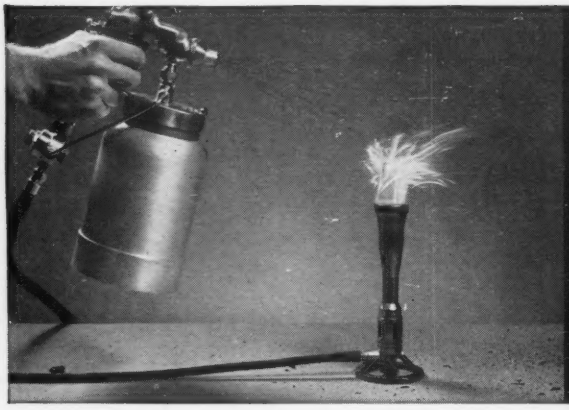
For further information mark No. 137 on Readers' Service Card

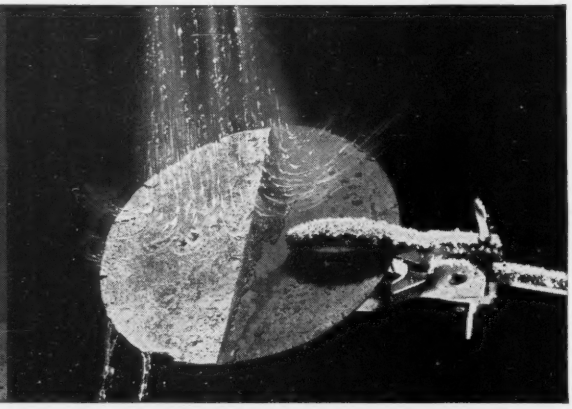
Improve product performance, cut costs with 3M Adhesives, Coatings and Sealers



VIBRATION RESISTANT. Tough aluminum strips (bonded in the middle, above) tear before 3M Brand EC-801 bond separates! This versatile sealer is especially suited for integral fuel tanks, keeps them tightly sealed in spite of vibration and flexing. Highly resistant to aircraft fuels; adheres firmly to metals at temperatures from −65°F. to 180°F.

MOISTURE RESISTANT. 3M Brand EC-1300 grips like a bear while wet, speeds rubber-to-metal bonding. Synthetic rubber base has light colour for less clean up. EC-1300 sets fast, bonds tightly with no cold flow under pressure. Bonds foam, sponge, extruded and mechanical rubbers fast with moisture-resistant, flexible film.





FIRE RESISTANT. This Bunsen burner can't ignite wet, 3M Brand Adhesive EC-321—proof this adhesive can safely be used anywhere on the assembly line. Ideal for bonding sound deadening pads, insulation batts and lightweight padding. High wet strength allows production to continue as adhesive dries. Apply with spray gun, brush or roller.

CORROSION RESISTANT. Rugged torture test! 2000 hours exposure to salt spray; 20 weeks submersion in 20% solution of hydrochloric acid; six-month weather exposure in Miami, Florida proved CORO-GARD* 1706 Brand Protective Coating resists abrasion and corrosion. For steel, aluminum, wood, concrete, cloth and some plastics.

*T.M. Reg'd.

SEE WHAT 3M ADHESIVES CAN DO FOR YOU! Look to 3M with your next adhesive, coating or sealer problem. Call your 3M Field Representative.

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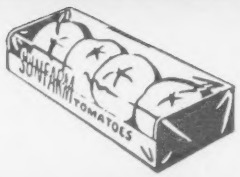

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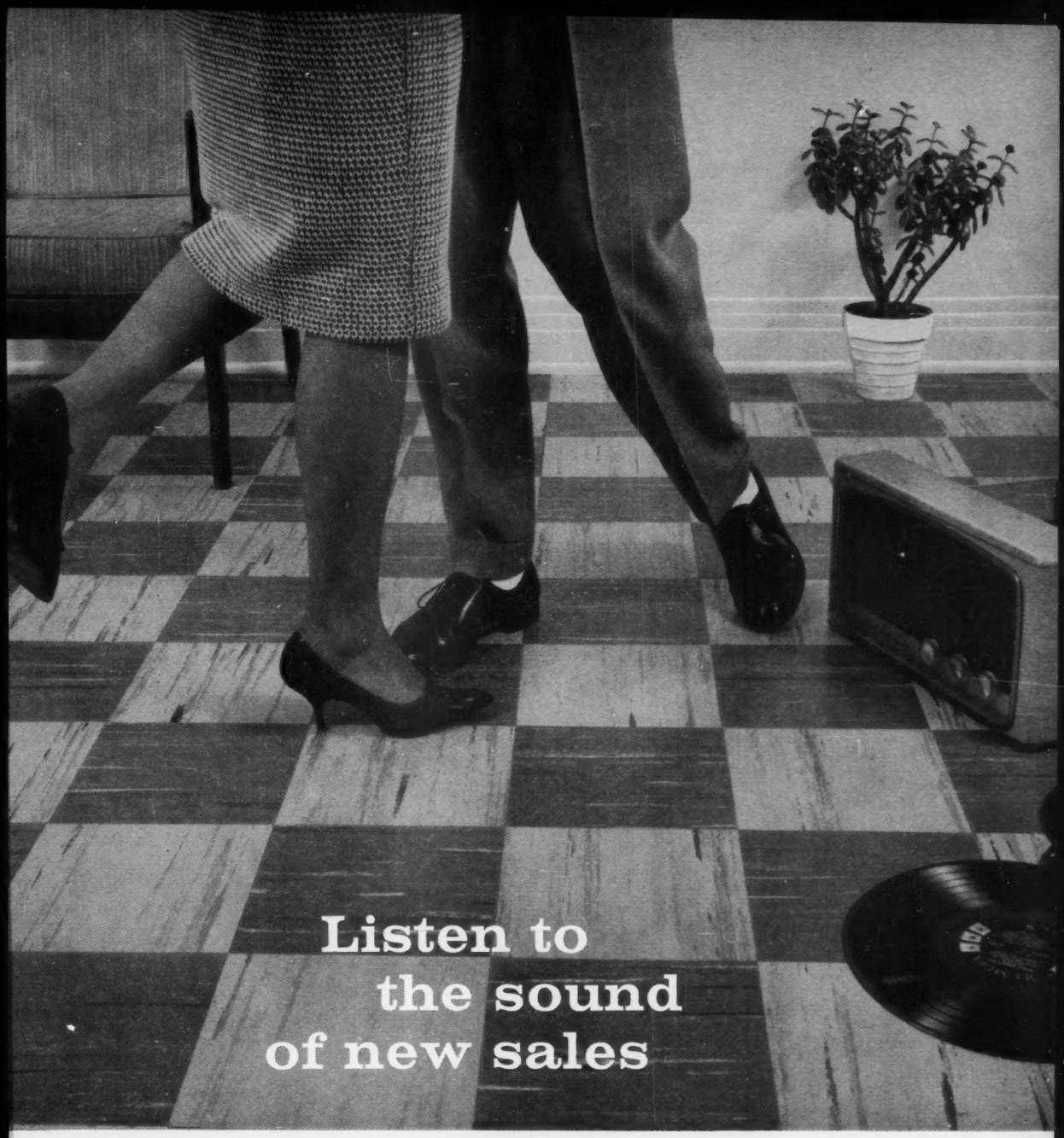

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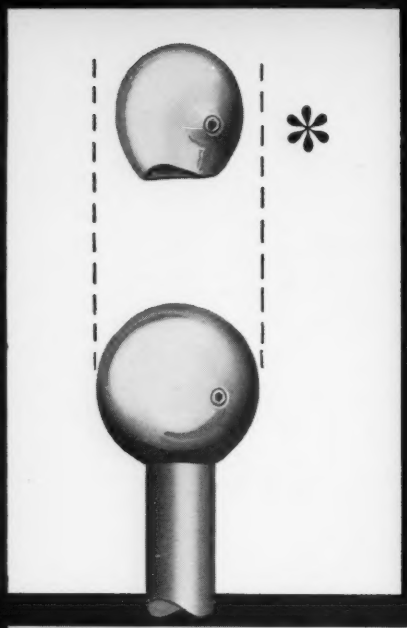
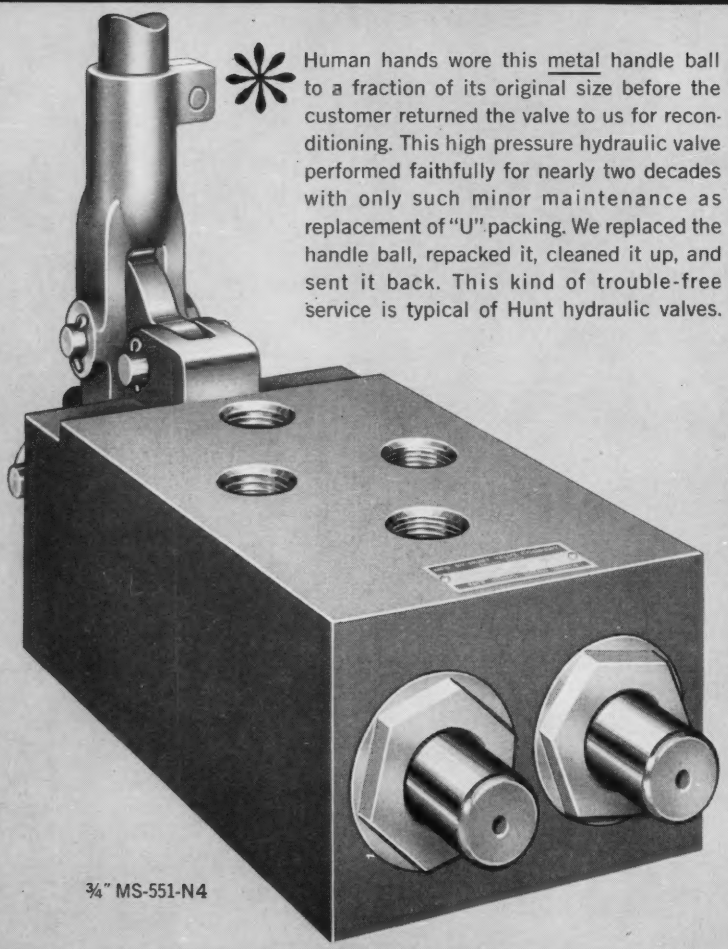
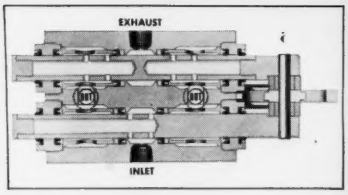


after 17 years... replacement parts ***one handle ball!***



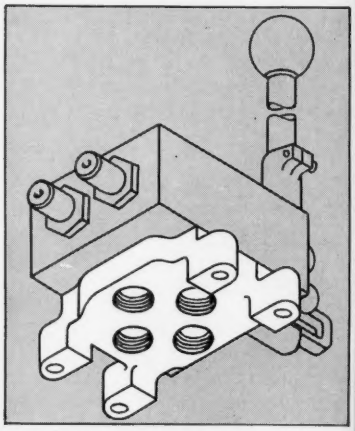
Human hands wore this metal handle ball to a fraction of its original size before the customer returned the valve to us for reconditioning. This high pressure hydraulic valve performed faithfully for nearly two decades with only such minor maintenance as replacement of "U" packing. We replaced the handle ball, repacked it, cleaned it up, and sent it back. This kind of trouble-free service is typical of Hunt hydraulic valves.

¾" MS-551-N4



The Higher the Pressure The Tighter the Seal

Cross-section view shows Hunt system of "U" packing as opposed to "metal to metal". "U" packing provides zero leakage on water hydraulic service.



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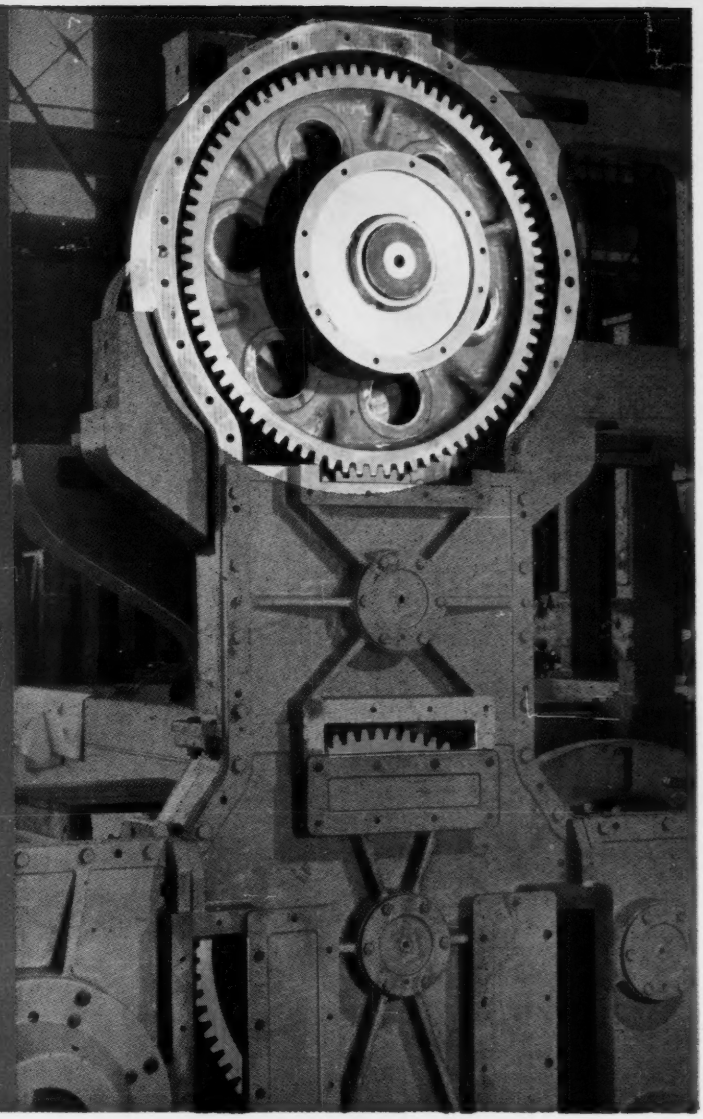

Built for Black-Clawson (Canada), Limited, these huge gears, for high speed paper production, were cast to give completely dependable, trouble-free operation. Once again, Canada Iron's technological facilities and large casting equipment were equal to the job.

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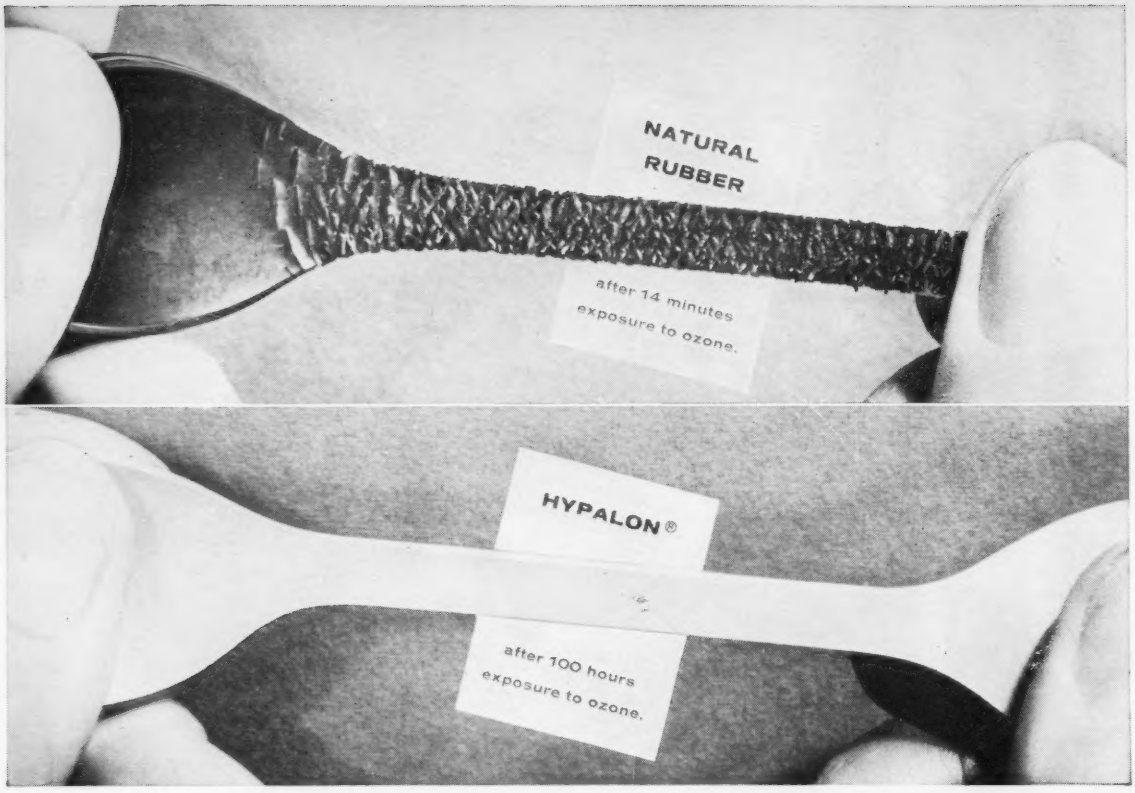
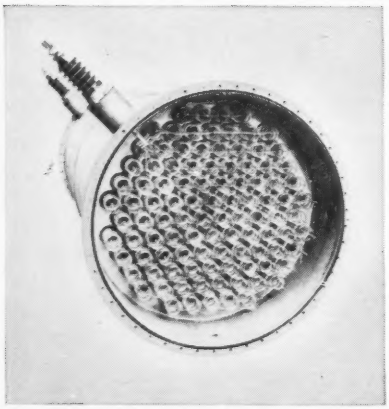


"Hypalon" is Completely Ozone Proof!



This ozone generator is equipped with a head gasket made of "Hypalon". While ordinary rubber gaskets would crumble in seconds, gaskets of "Hypalon" have been standard equipment since 1953. None has failed from ozone attack.

You can't see ozone . . . but you *can* see the ruinous effect this invisible gas has on ordinary rubber parts. That's why so many of today's maintenance parts are made of "Hypalon" . . . a synthetic rubber that's completely ozone-proof!

"Hypalon" never cracks or fails in ozone . . . resists ozone concentrations as high as 6% for extended periods of time. As a case in point, ozone generator head-gaskets made of "Hypalon" are still in service after more than five years.

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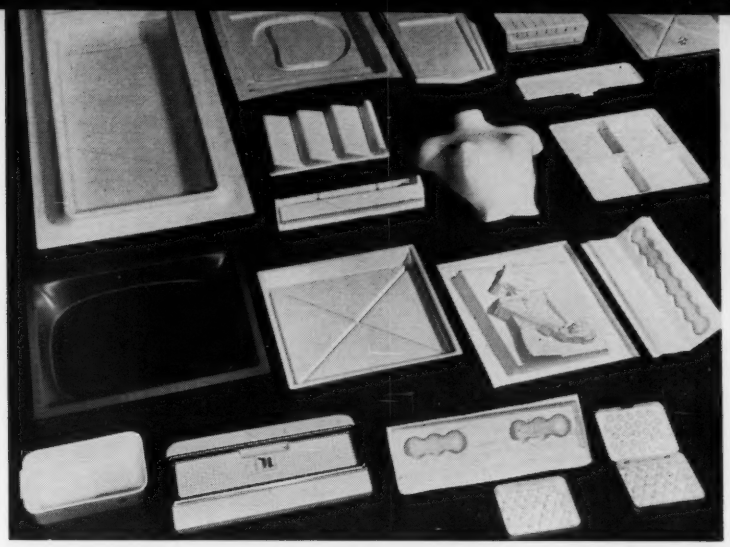
Design Engineering
November
1960



Plastics: a material to stir the designer's imagination

Polymers on verge of big break-through; the industry completely "future-oriented"

E. L. Littlejohn, P.Eng.
Union Carbide Canada Ltd.

Design engineers in Canada have only just begun to utilize the vast potential of today's plastics. Here is an expert's appraisal of the field past, present and future.

Production and acceptance of plastic materials have made great progress in this country since the first Canadian production of phenolic molding materials in 1911. It is no longer necessary to spell out the difference between thermoplastics and thermosetting materials. Today it is general knowledge that thermoplastics can be formed and reformed with heat, whereas thermosetting materials, once they are heated and cured, are not further affected by heat until they reach the charring point. Examples of the former group are the polyolefins, vinyls, polystyrenes, nylon, while examples of the latter group are the phenolics and melamines.

Plastics are counted among the major industrial raw materials; in North America they now exceed the major nonferrous metals in tonnage used. There are more than two dozen synthetic resins of major industrial importance. Over half of these have been developed since the war; ten of them are made in Canada.

There has been a tremendous advance in the Canadian standard of living during the past 15 years—a period in which the automobile, the automatic washing machine and drier, television and air-conditioned houses have almost become necessities for the average family. Each of these has created new markets for manufacturers of plastic materials.

It has been during this period that the design engineer has become aware of the design possibilities of plastics. Plastics are no longer considered substitute or replacement materials but are considered on their own merits of economy and performance. Recently an industrial designer stated that he could not visualize any multicomponent product that could not use some plastic materials to advantage. If a good designer could be described to have one qualification above others it would be imagination, and if any factor can stir the imagination it is surely the design potential of plastics.

There were many problems in the early days of plastics. Some products were not strong enough, perhaps a fault of design or a misapplication of material; others would break down when subjected to the chemical actions of products such as grease and soap; others were not sufficiently heat-resistant. However,

the material suppliers and the designers had faith and nearly all of these and other problems have been solved. Today we have impact-resistant styrenes, chemical-resistant polyolefins, extra-heat-resistant phenolics, melamines and a host of other plastic materials for almost every application. The designer today can take advantage of a vast assortment of plastic forming and fabricating processes, each imparting different properties and offering new design possibilities to the imaginative design engineer — a far cry from the first phenolic "cold molding" process.

While there is no doubt that plastics have replaced some of the older, more conventional materials, they have in many cases been used in combination to enhance or improve the properties of these materials as well. For instance, vinyl is now bonded to metallic surfaces for improved appearance, polyethylene is extrusion-coated onto Kraft paper to produce a product with the combined good properties of both materials.

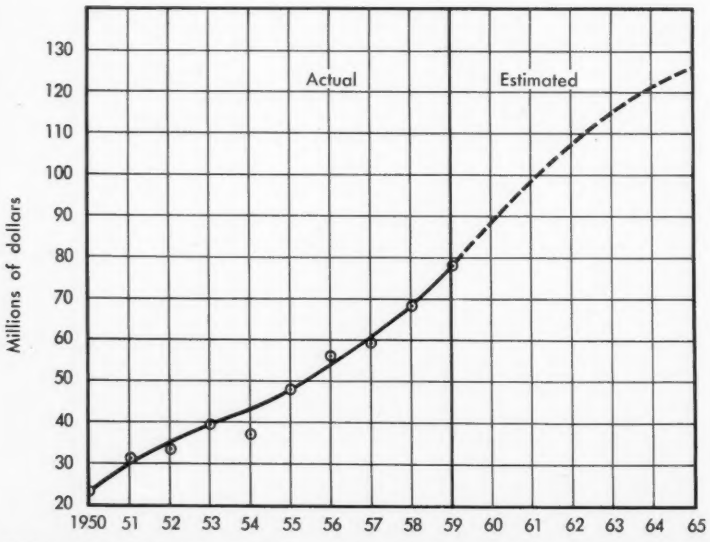
Some evidence of the current growth picture can be shown by a recent survey of the Canadian plastics industry by The Society of the Plastics Industry (Canada) Incorporated, in which it was determined that seven out of ten plastics manufacturers have expanded or plan to expand during 1960, increasing capacities up to 15%.

Industry looks to the future

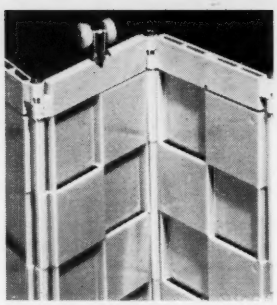
All of us in the plastics industry are "future oriented" and take every opportunity to speak of what the future holds for this young and vigorous industry. Some research people indicate that polymer chemistry is on the verge of a major break-through. They suggest that it will be possible with a knowledge of catalyst systems and materials to design a chemical process with the use of electronic computers to produce "tailor-made" plastics with predetermined properties.

The term "tailor-made" to fit your specifications will become a reality. A great deal of work has been done in this area by Professor Guilio Natta of the Milan Polytechnic Institute, Italy. In his work with propylene, butylene, and styrene gases and mixtures of these, he found that certain catalyst systems produced certain molecular configurations which resulted in predictable properties. Researchers will undoubtedly apply the same principle to vinyls, polystyrene and other additional polymers to produce new and different plastics. The possibilities stagger the imagination.

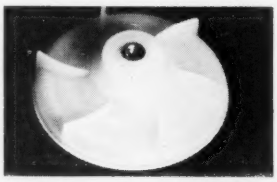
It is certain that the "Monsanto House of the Future" has stirred a great interest in the housing design field and it is conceivable that plastic preassembled insulated weatherproofed load-bearing panels incorporating heating and air-conditioning ducts will be available in the future. It is suggested that these will be available in different colors and it will be possible to assemble them in different ways to provide functional and attractive architectural variations. It is also suggested that the panels will be economical because of mass-production possibilities.



Value of molded and extruded plastic products made and sold in Canada.



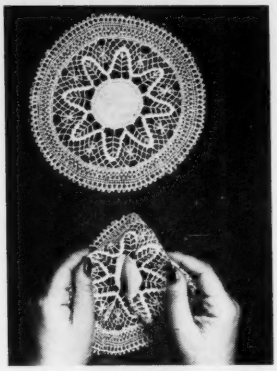
High-impact polystyrene was chosen for a Canadian-designed traverse screen. This close-up shows the molded pattern.



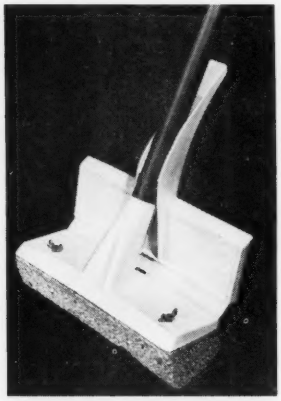
The properties of polypropylene make it ideal for this water pump impeller. It's lightweight, inert and moisture resistant.

Polypropylene again. This ball valve is shown assembled (top right) and with its various components.

High density polyethylene was chosen for this lunch kit, which weighs less than old-style kits, has greater capacity and is claimed to be more durable.



An unusual application for plastics is this lace-like place mat. The material is polyvinyl chloride.



Sponge floor mat makes excellent use of the "hot" and "flex" qualities of polypropylene. The head is molded in one piece, hinge and all.

A Wayne and Shuster prop. CBC used lightweight vacuum formed vinyl plastic for this promotion piece.

Research programs by manufacturers and designers suggest major advances in the field of appliances. The development of thermistors, which produce cold instead of heat, electrically, makes possible electronic refrigeration. Electronic ovens are a reality. Ultrasonic vibrations will clean clothes and wash dishes.

Plastics will continue to find ever-increasing use in the automotive industry. In our northern climate, with a great deal of auto corrosion caused by salt combinations which are put on the highways to melt snow and ice, who wouldn't welcome a corrosion-free autobody and frame made from epoxy-fibre glass?

Fabrics and textiles will be made from polypropylene and other plastic monofilaments. The development of polyolefinic copolymers opens up a whole new field of textile technology.

The boat-building industry is a prime example of how plastics have replaced older materials and at the same time permitted a new freedom of design. Polyester fibre-glass boats with flotation chambers filled with polyurethane or polystyrene foams are becoming an important part of a fast-growing business. Market research people now talk in terms of a boat for every family. Perhaps the greatest drawback to the construction of plastic boats is the lack of mass-production techniques, although a lot of progress has been made in this direction.

The package designer also has become well aware of the possibilities of plastic materials. The foremost plastic packaging material today is polyethylene film. Tests indicate that today's polyethylene film is three to four times clearer than film sold just a few years ago. Equally as important is the soft warm texture of the film—a property that lends the bakery product, for instance, an added "feel" of freshness. Polyethylene film is now also becoming popular as an overwrap for paper products.

Builders and construction engineers have taken advantage of polyethylene film's moisture resistance and used it as a moisture vapor barrier and as a concrete highway underlay, or as a curing blanket for concrete highways.

What can a design engineer find in plastic materials that make it advantageous for him to use them?

1. He will find that wherever a large volume of parts are concerned (this could be between 5,000 and 5,000,000, depending on circumstances) it is quite often more economical to mold the part of plastic than to fabricate or form it from other materials. Any custom molder in Canada will be glad to give cost estimates.

2. Because of advances in plastic molding techniques, a greater flexibility of design is possible.

3. Surface and color effects can be incorporated with minimum cost for the greatest effect.

4. A wide variety of physical properties can be obtained by proper choice of materials.

Progress in tooling with plastics

This article would be incomplete without some reference to the progress which has been made in tooling with plastics. Plastics have contributed in many ways to reduction in costs of tools, dies and fixtures for use in the fabrication of articles made from metal, plastics, glass and wood.

Some of the advantages of plastic materials over tools of metal or wood are:

1. Tools can be cast or laid up to the desired final shape and dimensions in one operation.

2. Relatively inexpensive equipment and labor, and fewer manhours are required.

4. Duplication is easier where several tools are required.

5. Revisions and repairs are simpler and less costly.

6. The tools are relatively light in weight, and easy to handle.

7. The tools are resistant to corrosive atmospheres, lubricants and weather and thus can be stored outdoors.

The major disadvantage is that the tools made from plastics do not wear as well as metal tools when forming metal parts. For instance, a die for an automobile part was made from plastic because only 10,000 pieces were required. If 100,000 metal pieces had been required, the design engineer undoubtedly would have specified metal dies. This is why plastic tooling is especially valuable to Canadian tool designers where relatively short runs are common. Epoxies, phenolic and polyester resins are the three major types used in tooling. Also vinyl and silicones are used as parting or release agents. You will hear more about the design capabilities of various plastics in the articles to follow.

The plastics industry in Canada has a great faith in the potentials of plastic materials. The limits of the use of plastic materials by the design engineer surely are the limits of his own imagination. ★

Plastics for Canada's design engineers

A fourteen-page summary on the eleven major basic types

Plastics are man-made materials, in contrast to nature's materials like wood and metal. A generally accepted definition is: Any one of a large and varied group of materials consisting wholly or in part of combinations of carbon with oxygen, hydrogen, nitrogen, and other organic and inorganic elements which, while solid in the finished state, at some stage in its manufacture is made liquid, and thus capable of being formed into various shapes, most usually through the application, either singly or together, of heat and pressure.

Plastics are a family of materials—not a single material—each member of which has its special properties.

Being man-made, plastics raw materials are capable of being variously combined to give most any property desired in an end product. But these are controlled variations, unlike those of nature's products.

The widespread and growing use of plastics in almost every phase of modern living can be attributed in large part to their unique combinations of properties. It must be remembered that there are both advantages and disadvantages in the application of plastics to any particular design problem. Certain plastics will tip the balance to the credit side, while the use of other plastics might prove disastrous. These are the decisions the designer engineer must make — and to make these decisions he must be equipped with all the facts.

The following are brief outlines of some of the facts concerning the major classifications of plastics available to the designer in Canada today. They are by no means all the facts required to make sound decisions in this important area of materials.

We recommend that you consult your major material suppliers before embarking on any new project involving plastics. They are most anxious that you get the best value for the money you spend for their products. They are even more interested in ensuring that their materials do not get misapplied. In the long run we are certain that their particular experience will save you, the design engineer, both time and money.

Four points to remember:

1. Almost anything can be made from any plastic; and if properly designed, it will be satisfactory unless the environment in which it operates causes the degradation of the material at a rate faster than economies will permit. Therefore choose your material with a view first of all to its environment, and secondly to the combination of useful properties which permit the most economical design.

2. The injection molding process is one of the most versatile production methods available and the construction of most parts can be simplified when this method is used to make them.

3. Be wary of the mere substitution of plastic for some other material, without redesign. Plastic replaces other materials successfully only where the function of the part to be made is considered with regard to the properties of the plastic and their difference from the properties of the other material in use.

4. Design your part in whatever plastic type seems most desirable but do not try to use the types interchangeably.

Acrylics

Information supplied by
Canadian Industries Limited

Twenty years ago the only important commercial application for acrylics was the aircraft canopy. Today the range of applications for acrylic resin is so diverse, and the development of some so advanced, that aircraft canopies are now but a minor consideration. Illuminated signs, lighting diffusers, television implosion guards, sink units and bath-tubs, boat-shields and automotive components are some of the many and varied applications which consume acrylics in large volume today.

Properties

In unpigmented form, acrylic sheet has a light transmission of 92%. Weathering has no effect on the mechanical properties and, in pigmented form the degree of color change is insignificant even after many years' exposure to tropical conditions. Mechanically, the properties depend on the temperature at which they are measured and the degree of stress or strain imparted in the molding or shaping operation. Typical values for unplasticized cast sheet are given on page 55.

During the process of producing double-curvature shapes from flat sheet stretching inevitably takes place. The surface area is increased and the thickness correspondingly decreased. Despite this decrease in thickness the impact strength increases, in some cases to a marked extent. This phenomenon cannot be measured in general terms. The graph on page 55 plots the impact strength of a typical unplasticized cast acrylic sheet in four stages of stretch, relative to thickness.

Heat distortion temperatures vary between 150 F and 203 F, dependent on grade, with unplasticized cast sheet lying in the upper limits of this bracket. Abrasion resistance, unusually high for a thermoplastic material, is comparable with that of aluminum and because the material is indented rather than removed the resultant optical effect is rarely noticeable in service.

The shaping of sheet

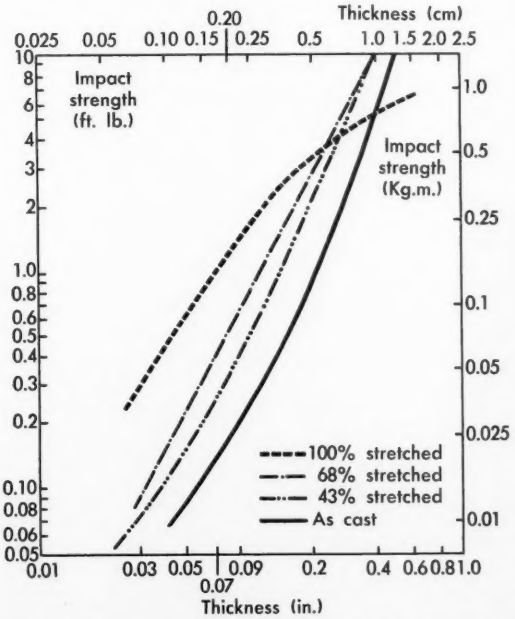
The shaping of acrylic sheet is basically a simple process requiring a low capital outlay in machinery and molds. The essential equipment comprises ovens capable of heating up to 400 F (with a control of ±51 F in the higher ranges), presses developing thrusts up to 7 tons, an air supply up to 150 psi and a vacuum system. Molds can be made from metals, hardwood, phenolic laminates, and reinforced plaster. Welding techniques similar to those used on polythene and rigid pvc sheets, are satisfactory and both solvent cements and acrylic based cements are widely available.

Acrylic sheet softens to a rubber-like state when heated above 250 F; however, for shaping purposes the sheet temperature should be between 300 F and 350 F. The choice of mold design and of pressure medium depends on the product in question. From the equipment described, either positive ram pressure, air pressure, or vacuum are the alternatives. Normal practice uses a combination of two, and sometimes all three, of these media.

Acrylic sheet, when hot, is sensitive to mold mark: consequently design of tool and choice of pressure system depends not only on the required thickness distribution in the product but also on the importance of retaining the high lustre finish on all or a significant part of the shaping. Mold-mark on an aircraft canopy, for instance, is prohibitive; however, on a sign which will subsequently be silk-screened and back-sprayed, mold-mark is not so serious.

Property	*Units*	*Mean Value*	*Standard Deviation*	*Remarks*
Tensile strength	lb./sq. in. kg./sq. cm.	10,000 700	600 40	
Flexural strength	lb./sq. in. kg./sq. cm.	16,000 1,125	1,200 85	
Shear strength	lb./sq. in. kg./sq. cm.	10,000 700	300 20	
Impact strength	ft. lb. per inch of notch	0.32 0.45	.. —	ASTM Notch 0.010 in. radius BS 488. Notch 0.040 in. radius
Modulus of elasticity in flexure	lb./sq. in. kg./sq. cm.	4.25×10^5 3.0×10^4	0.25×10^5 0.18×10^4	Moduli in tension and compression substantially the same
Pyramid hardness	—	22	—	In accordance with BS427
Poisson's ratio	—	0.35	—	

Typical general properties of cast acrylic sheet.



Impact strength of a typical unplasticized cast acrylic sheet in four stages of stretch.

Applications for sheet

Illuminated outdoor signs, interior and exterior lighting diffusers and both commercial and transport glazing are the three largest volume applications for acrylic sheet in Canada. However, lesser known uses for sheet are under development in North America following successful application in other parts of the world, where economic necessity — lack or high cost of traditional materials — has encouraged a closer attention to the possibilities of synthetics.

Such applications as washbasins, sink units, and bathtubs, were attracted to acrylics because of their ease of fabrication, resistance to straining and homogeneous pigmentation.

Television implosion guards, in some countries, have turned to acrylic sheet with the advent of compact portable television units. Both guard and surrounding trim and casing are molded in one operation. Low cost of tooling and flexibility in design are one of the significant advantages of acrylic in this end use.

Domelights, roof-tiles, trays, cigarette boxes, counter dividers, ice-hockey masks, pressure gauge glasses are some of the many small and large applications in which acrylic sheet is used.

Injection molding of acrylic

Molding powder either in chip (compound) or fine powder (polymer) form, can be molded on conventional

Toilet table and washbasin made from acrylic sheet.

continued ▶

injection molding equipment. A reasonably high injection pressure is needed and a heating cylinder designed for good pressure transmission is an essential requirement. Melt temperature of approximately 445 F is normal. General conditions of mold design apply although cavities should be slightly oversize to accommodate the inherent shrinkage which occurs to the extent of 0.004 in.-0.008 in.

By far the largest single application in Canada for acrylic molding powder is automotive accessories, particularly tail light lenses. However, there is a large market, in other parts of the world, for street lighting diffusers, interior "egg-crate" louvre diffusers, telephones, brush backs and medallions of all types. One interesting application in Germany has been the molding of gramaphone records. It was considered that acrylics gave better reproduction quality and a longer wear life.

Extrusion of acrylic

Successful extrusion of acrylic powder and compound is a relatively recent development and a technique which could well become equally important as injection molding.

The best known extruded applications are rods and tubes. However, extruded sheet is in successful development and profile extrusions, particularly for the lighting industry, are increasing in popularity. So far, extruded acrylic does not compare either in surface quality or in its mechanical properties with cast acrylic; however, in certain applications, where the powder is extruded to the finished article in one operation, without passing through the two stages of sheet manufacture and fabrication, substantial savings can be achieved.

Cellulosics

Information supplied by
Canadian Chemical Company Limited

Cellulosics, which include both the first thermoplastic (cellulose nitrate, 1868) and the first injection molding material (cellulose acetate, 1932), are characterized by exceptional toughness. All except cellulose nitrate are processed on conventional molding and extrusion equipment.

Among current large volume products in cellulosics are optical frames, telephone handsets, automotive parts, toys, photographic film base, clear packaging films, and sheets for vacuum forming.

Generally speaking, parts molded of cellulosic materials have a fine, lustrous surface. The cellulosics are available in a complete range of colors, including transparents and clear. In addition to the toughness for which cellulosics are usually selected, they are relatively free from problems associated with static charges.

Fan housing and lawn sprinkler are examples of applications for cellulose propionate molding material.

High dielectric strength and good electrical properties make cellulosics effective in numerous electrical applications.

A number of properties for each of the cellulosic types are shown in the accompanying table. A property table of this type is helpful in determining ranges into which a given material may be located, but often the best criterion for selecting a material for a proposed job is to make a few sample moldings which can be evaluated. Ranges are given for most properties in this table and it should be clearly understood that specific materials are limited to possible combinations of properties; for example, Izod impact is highest on the more highly plasticized (softer) types, and therefore the hardest type cannot also possess the highest Izod impact value.

Cellulose acetate

Cellulose acetate molding material is made from cellulose acetate flake combined with plasticizers and stabilizers with or without addition of coloring agents. Cellulose acetate molding exhibit toughness superior to most other general purpose plastics. Flame resistant formulations are currently specified for small appliance housings and for other uses requiring this property.

Present uses for cellulose acetate molding materials include toys, buttons, knobs, and products which require combined toughness and clear transparency.

Extruded film and sheet of cellulose acetate provide packing materials which maintain their properties over long periods. Here also the toughness of the material is advantageously used in blister packages, skin packs, window boxes, and overwraps. It is a breathing wrap, solvent and heat sealable. The grease resistance of cellulose acetate sheet allows its use in packaging industrial parts with enclosed oil for protection.

Cellulose propionate

Cellulose propionate offers advantages over cellulose acetate for many applications. Because it is "internally" plasticized by the longer chain propionate radical, it requires less plasticizer than cellulose acetate of equivalent toughness.

Because cellulose propionate absorbs much less moisture from the air, it is more dimensionally stable than cellulose acetate. This permits its use often when metal inserts and close tolerances are specified.

Largest volume uses for cellulose propionate are as industrial parts (automotive steering wheels, armrests, knobs), telephones, toys, pen and pencil barrels, and toothbrushes.

Cellulose acetate butyrate

Cellulose acetate butyrate has excellent toughness plus good dimensional stability. As with propionate, butyrate requires less plasticization than acetate or nitrate with the result that use of inserts is less criical and closer tolerances may be held.

Special formulations of butyrate are recommended for outdoor use. Extruded monofilaments of CAB take advantage of this weatherability in garden furniture. Clear sheets of cellulose acetate butyrate are finding use in vacuum forming applications. It is one of the few clear sheet materials with good aging properties. Large volume applications for butyrate include steering wheels, telephones, pen and pencil barrels, and rigid pipe. Films of cellulose acetate butyrate are also finding electrical uses.

Cellulose nitrate

Cellulose nitrate is the oldest of the thermoplastics. Celluloid (as it was known) was originally developed as a material for billiard balls. Among thermoplastics, it is unequalled for toughness. For many applications today, however, cellulose nitrate is not practical because of serious property short-comings: heat sensitivity, poor outdoor aging, and very rapid burning.

Cellulose nitrate cannot be injection molded or extruded by the non-solvent process because it is unable to withstand the temperatures these processes require. It is sold as films, sheets, rods, or tubes, from which end products are fabricated

Cellulose nitrate yellows with age; if continuously exposed to direct sunlight, it yellows faster and the surface cracks. Its rapid burning must be considered for each potential application to avoid unnecessary hazard.

The outstanding toughness properties of cellulose nitrate lead to its continuing use in such applications as optical frames, shoe eyelets, ping pong balls, and pen barrels.

Ethyl cellulose

Ethyl cellulose, a cellulose ether produced by the reaction of ethyl chloride on alkali cellulose, has the toughness characteristics of all the cellulosics with the added advantage of maintaining serviceable impact resistance to temperatures as low as —40 F. Ethyl cellulose has less dimensional change with moisture variation than any other cellulosic plastic, and it is the lightest. Somewhat limited in color range, it is less abrasion and scratch resistant than the other cellulosics. Typical current ethyl cellulose applications include football helmets, equipment housings, refrigerator parts, and luggage.

Cellulose fibres comprise one of the industry's largest-volume types and their end products range from gossamer curtain fabrics to coarse and rugged tarpaulins.

	Property	*ASTM method*	*Cellulose acetate*	*Cellulose propionate*	*Cellulose acetate butyrate*	*Ethyl-cellulose*	*Cellulose nitrate*
Physical	Specific gravity	D792	1.24-1.34	1.17-1.22	1.15-1.22	1.09-1.17	1.35-1.40
	Tensile strength, psi.	D638	1900-8500	2000-7000	2600-6900	2000-8000	7000-8000
	Izod impact	D256	0.4-5.2	0.6-11.0	0.8-6.3	2.0-8.0 (0.3-1.7@ –40F.)	5.0-7.0
	Rockwell hardness	D785 R-scale	35-125	20-115	30-115	50-115	95-115
	Water absorption 24 hr., %	D570	1.9-6.5	1.2-2.0	1.1-2.2	0.8-2.0	1.0-2.0
	Refractive index	D542	1.48	1.48	1.48	1.47	1.48
	Dielectric constant 10^3 cycles	D150	3.5-7.0	3.6-3.9	3.3-6.3	3.0-4.1	7.0
Chemical	Effect of weak acids	D543	Slight	Slight	Slight	Slight	Slight
	Effect of strong acids	D543	Decomposes	Decomposes	Decomposes	Decomposes	Decomposes
	Effect of week alkalies	D543	Slight	Slight	Slight	None	Slight
	Effect of strong alkalies	D543	Decomposes	Decomposes	Decomposes	Slight	Decomposes
	Unaffected or only slightly affected by:		Alcohols Hydrocarbons Most Esters	Alcohols Hydrocarbons	Alcohols Hydrocarbons	Glycerine N-Hexane	Hydrocarbons Weak mineral Acids @ rm. temp.
	Soluble in: (Work as adhesives)		Ketones and Cyclic ethers	Ketones Esters	Ketones Esters	Ketones Esters	Ketones Esters
Thermal	Burning rate	D635	Slow to self-extinguishing	Slow	Slow	Slow	Very Rapid
	Heat distortion temp., °F.	D648	110-205	110-200	115-200	115-190	140-160
	Continuous resistance to heat, °F.		140-220	155-220	140-220	115-185	140
	Injection molding temp., °F.		335-490	355-515	335-480	350-500	(Not moldable)

Comparison of properties for each of the types of cellulose plastics.

continued ▶

Epoxies

Information supplied by
Shell Oil Company of Canada

Cured epoxy resins are inherently strong, tough, chemically stable polymers that combine a great number of desirable characteristics. Excellent physical strength, outstanding adhesion to metals, glass and other plastics, good electrical properties, and resistance to a very broad range of chemicals and solvents are all obtainable in a single material.

Raw epoxies are really chemical intermediates. They cannot be polymerized by the use of heat alone and are practically never used by themselves. To produce useful products they must be converted chemically by combining them with other resins, catalysts or hardeners, or reacted with the fatty acids of vegetable oils. The primary resin-hardener combinations can be further modified with fillers, pigments, plasticizers or extenders to produce surface coatings, castings, laminates and adhesives of outstanding ability. Since the choice of curing pigments and other modifiers is very broad, the possible number of useful combinations is legion and it is fair to say that only a fraction of the potentially useful combinations have been investigated.

Raw resins

The common commercial epoxy resins are condensation products of bisphenol A and epichlorohydrin. Over 50 types are available from North American manufacturers and range from moderately viscous liquids to hard, tough solids. The properties of the five principal types are shown in the next column.

Epoxy resin coatings

Surface coatings, and particularly metal primers, represent the largest field of use for these resins at the present time. They contribute improved corrosion resistance and protection against stone chipping in new, high-performance automotive primers by virtue of their chemical stability and long-term flexibility retention. Epoxy-acrylic enamels make successful unicoat finishes for appliances because they combine excellent gloss and hardness, coupled with good detergent and stain resistance. Dry powder coatings applied by a fluidized bed technique can be used to coat the most intricate parts (such as motor stators) in a single operation at high production rates.

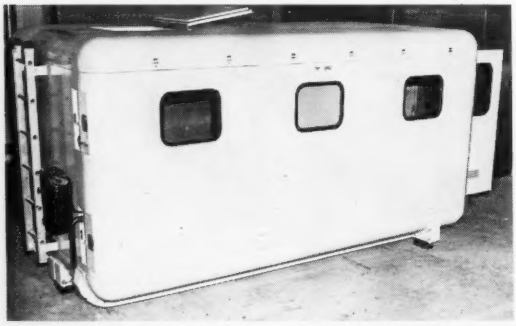
Types of finishes	*Method of application*	*Typical curing schedules*	*Typical end uses*
Epoxy-Phenolic	Spray, roller coat, dip coat, flow coat	20 min. at 375 F.	Can, drum and tank linings; pipe linings; wire coatings and impregnating varnishes
Epoxy-Urea	Spray, roller coat, dip coat, flow coat	20 min. at 300 F. — clear 20 min. at 385 F.— pigmented	Can linings; appliance primers; clear coatings
Epoxy-Polyamine	Spray or brush	Air dry or bake 10 minutes at 250 F.	Coatings for machinery, process equipment and structural steel for use in chemical plants; linings for transmission pipelines
Epoxy Resin Esters	Spray, roller coat, dip coat, flow coat, brush	Air dry or bake 20 min. at 325 F.	Overprint varnishes; primers for autos, appliances and other equipment

Application and properties of epoxy resin finishes.

Epoxide equivalent[1]	*Color (Gardner)*	*Melting Point °C.*[2]	*Viscosity*[3] *@ 25C. Poises*	*Gardner-Holdt*
175-195	5 Max.	Liquid	5-9	—
180-195	5 Max.	Liquid	100-160	—
425-550	4 Max.	65-75	1.0-1.6	D-G
875-1025	4 Max.	95-105	4.3-6.2	Q-U
1550-2050	5 Max.	125-135	17-27	Y-Z_1

1—Grams of resin containing 1 gram equivalent of epoxide
2—Durrans mercury method
3—On liquid types as supplied—on solids as 40% solutions in butyl carbitol

Properties of the five principal types of commercial epoxy resins.



Prototype of a shelter now being tested in the north for the Canadian Army. Epoxy resin was used primarily because of its strength in relation to weight.

Chemicals	*Appearance changes Specimens*	*Changes in flexural strength psi Original*	*After 80 days immersion*
50% Sodium hydroxide	Slight surface dulling	19,800	20,900
25% Sulphuric acid	Slight surface dulling	19,800	15,000
25% Hydrochloric acid	Considerable darkening	19,800	15,600
40% Formaldehyde	Slight edge swelling	19,800	14,400
25% Chromic acid	Slight chalking	19,800	18,300
28.5% Sod. Al. Sulfate	Some slight darkening	19,800	18,900

Chemical resistance of unmodified liquid epoxy after 180 day immersion at 180 F.

Epoxy resin coatings should be considered wherever resistance to physical abuse and chemical environments are design criteria.

Epoxy resin castings

The liquid epoxy resins are used to produce casting formulations, characterized by high physical strength, excellent electrical properties, low shrinkage during cure and outstanding chemical resistance. These properties have led to the adoption of liquid epoxies for encapsulating electrical components and for plastic tooling including duplicate master patterns, forming tools for the aircraft industry, and core boxes for foundry use. Epoxies are also used to mold special chemical equipment, such as tanks for use in high-speed photographic development processes. Casting formulations have also been successfully used to repair metal parts, particularly in areas where the use of conventional welding or soldering processes would be hazardous.

Epoxy resin laminates

Liquid epoxy resins can be used to produce fibreglass reinforced laminates by essentially the same methods used for polyester resins. The laminates so produced in general have a higher modulus, superior inter-laminar sheer strengths, better heat resistance, and superior chemical resistance, particularly to alkalis.

Because of their excellent dimensional stability, epoxy laminates have been used for holding and checking fixtures in both the aircraft and automotive industries. They are used as prime structural parts in aircraft because of their exceptionally high strength/weight ratio and excellent resistance to fatigue where cyclical stress is a factor. Excellent electrical properties have led to the use of epoxy laminates in printed circuitry.

Epoxy resin adhesives

Epoxy resins adhesives have become well established in the aircraft industry because they provide high bond sheer strengths, excellent resistance to elevated temperatures and are unaffected by fuels and hydraulic fluids. The use of epoxy adhesives in industry is steadily increasing because of the ability of these products to bond metals, glass, wood and other plastics at ambient temperatures. Because no volatile solvents are present high clamping pressures are not necessary and simple contact pressure assemblies generally produce strong bonds.

Nylon (Polyamides)

Information supplied by
Du Pont of Canada Limited

Nylon is chemically defined as a linear polyamide which will form orientable filaments. Nylon for molding use is produced in pellet form rather than as filaments and is processed by injection into a mold while in a molten state.

There are four types or kinds of nylon. The type numbers are related to the number of carbon atoms between amide linkages. Modifications of these basic structures for special purposes are made by co-polymerization and/or mixing.

Types 6/6 and 6 are the bases of the general-purpose molding powders. Types 6/10 and 11 are generally applied as extrusion materials, but their special properties may be useful in some moldings. Type 6/6 is the only type made in Canada.

Several components in the redesigned Electrolux vacuum cleaner are molded of nylon resin. The large white unit in the centre is an air-filter frame.

Properties

Nylons are generally unaffected by such solvents as the ketones, chlorinated hydrocarbons, petroleum products, oils and greases at temperatures below their melting points. Like most design materials, however, they are affected by certain chemical environments, notably mineral acids, strong alkalies, oxidizers, alcohols, phenolic chemicals and formic acid. Water plasticizes nylon slightly, greatly improving its toughness.

Each type of nylon has a different melting point. *For most practical purposes, the upper limit of usefulness or working temperature is considerably below the crystalline melting point of the nylon.*

In air, nylons are completely stable at normal temperatures but begin to oxidize and embrittle at temperatures above 140 F. This effect is very slow up to 175 F but speeds up as the temperature increases and becomes appreciable at temperature over 200 F.

Special heat-resistant fomulations of nylons are available, which increase the service life at elevated temperature. For each type of nylon, however, the upper limit of usefulness is still proportional to its melting point.

All nylons will absorb water. The amount absorbed depends upon the type of nylon, the humidity of the environment and the time exposed.

This absorption of water is beneficial since it causes plasticization, and at least a minimum amount is necessary to ensure toughness in a nylon part.

The rate of loss of moisture in dry air is approximately the same as the rate of absorption in 100% humid air at the same temperature.

Moisture absorption is accompanied by an increase in dimensions in moldings of Types 66 or 6 which are essentially strain-free. This change will amount to

0.00025 inches per inch per 1% moisture pick-up or about 0.00065 inches per inch to normal equilibrium in air (2.5% moisture for Type 66). A total growth of 0.0026 inches per inch should be allowed where the part will be totally immersed in water during service.

The plasticizing effect of water results in loss of stiffness and tensile strength as moisture is absorbed. From the dry-as-molded state to air-equilibrium (2.5%) the stiffness of Type 66 nylon will decrease about 50% and the tensile yield point will drop from around 11,000 psi to around 8,000 psi. The elongation (strain at rupture) will increase in toughness.

All nylons can be given substantial protection by incorporating 2 to 2½% of finely divided carbon black and dispersing it evenly. Only compositions containing carbon black should be used where exposure to direct sunlight cannot be avoided.

Design considerations

Most of the uses for nylon are for mechanical components which must fit into an assembly. Therefore, tolerances must be often held much more closely than is the custom with molded housewares, personal articles and the like. Some molders are achieving tolerances in the order of three mils on one-inch parts and six mils on parts of three to four inches in one dimension. The resilience of all nylon types permits wider permissible tolerances than is the custom with metals, and in many uses, such as bearings, the close tolerances used in metal design are disadvantageous and should not be specified.

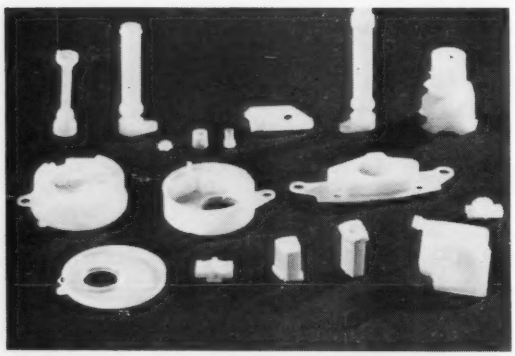
Nylon parts can be designed using exactly the same principles of design applied to other engineering materials, but with different values assigned. Notwithstanding the availability of good design data, it is wise to insist on prototype testing, with the part machined from rod or bar stock, or molded in test cavities, to avoid the possibility of failure from unforeseen operating conditions or environment. There are no known techniques for casting nylon in open molds, and this method cannot be used for prototyping or production.

The uses of nylon are increasing all the time. As an engineering material its most important uses, perhaps, are for bearings, gears, cams and other mechanical parts in the automotive industry and as parts of textile machinery for thread guides, spinning equipment, looming and winding machines.

In household appliances, its long life, quiet operation, little or no need for lubrication, and economy are spreading its use. Eggbeater gears, rollers and slides for kitchen cabinet and stove drawers, washing machine parts, refrigerator locks, fan parts and the like are common instances of effective use of nylon.

Office equipment parts, dials, ratchets and cams offer similar advantages. In electrical applications, nylon has two types of use: jacketing for wire and cable and molded components. It is chosen usually for its toughness, resistance to heat and abrasion and good insulating properties.

Nylon is found in such diverse applications as pressure gauge parts, valve seats, telephone switching equipment, battery cases, gears, cams and as bearings in cameras and projectors.



Molded nylon parts in a newly designed lightweight power saw. The plastic components reduce weight and cost.

Temp	*6-6*	*6-10*	*6*	*11*
0F	12,500 psi	10,000 psi	12,000 psi	10,000 psi
70F	11,000	7,000	7,000	7,000
150F	10,000	5,500	6,000	3,500
250F	3,500	2,500	2,500	1,500

Tensile yield strength of nylon (equilibrium moisture).

Chemical	*Type 6-6*	*6-10*	*6*	*11*
Mineral acid weak	(degrades (slightly	resistant	degrades slightly	resistant
Mineral acid strong	degrades	degrades	degrades	degrades
Alkalies weak	resistant	resistant	resistant	resistant
Alkalies strong	resistant	resistant	resistant	resistant
Oxidizer				
HNO_3	degrades	degrades	degrades	degrades
ClO_2	"	"	"	"
$KMnO_4$	"	slightly	"	slightly
H_2O_2	"	degrades	"	degrades
Oxidizers hot air	"	"	"	"
ozone	(degrades (slightly	degrades slightly	degrades slightly	degrades slightly
Phenolica-Phenol	dissolves	dissolves	dissolves	dissolves
Resorcinol	"	"	"	"
Cresol	"	"	"	"
Alcohols-Methyl	resistant	resistant	softens slightly	resistant
Ethyl	softens slightly	softens slightly	softens	softens slightly
Propyl	softens	"	dissolves	"
Butyl	softens slightly	"	softens	"
Formic acid	dissolves	dissolves	dissolves	degrades
Oxalic acid	degrades	degrades	degrades	degrades
Water	plasticizes slightly	resistant	plasticizes slightly	resistant
Glycols-at 200°F	plasticizes	plasticizes	plasticizes	plasticizes
Higher alcohols-200°F	"	"	"	"

Increased heat speeds up degradation, solution or absorption.

Effect of some chemicals on nylon at room temperature.

Phenolics

Information supplied by
Varcum Chemical Corp. (Canada) Ltd.

Phenolics are thermosetting materials some of which have been on the market since 1909. They are available in a number of different forms, depending upon the method of processing into finished products.

Molding compounds

Phenolic molding compounds have for many years been referred to as the workhorse materials of the plastic industry.

Strong and hard. Phenolics are hard, rigid and strong. The average phenolic will withstand knocks such as are common to camera housings. Special impact-resistant phenolics (up to 20 times as strong) can be employed where use is even more rigorous. Its surface will give excellent service under severe conditions.

Heat and cold resistant. Phenolics as a whole have good heat resistance up to 300 F. Mineral and glass reinforced phenolics have good heat resistance up to 400 F continuous. They are, moreover, poor conductors of heat which makes them cool to the touch when used for handles of cooking utensils. They do not support combustion. A special heat-resistant type is available. Phenolic parts suffer no marked change from food freezing temperatures.

Electrical characteristics. Phenolics are excellent electrical insulators. Special low-loss electrical insulating phenolic material is available.

Chemical and water resistant. Water, alcohol, oils, greases, mild acids and common solvents do not adversely affect phenolic parts. These fluorocarbons are resistant to extreme heat and cold, retaining their strength and dielectric properties over a very wide temperature range. Polytetrafluoroethylene withstands temperatures from —100 F. to 550 F.; polychlorotrifluoroethylene from —320 F. to 390 F.

Electrical qualities. These plastic materials offer high arc resistance and dielectric strength and low electrical loss.

Phenolic resins

Typical applications of the resins are in brake linings, radio speaker diaphragms, grinding wheels, pulleys, handles, dials, knobs.

This plastic has many physical properties similar to the molding compounds. It offers high strength, durability, dimensional stability, good electrical characteristics. It is dark in color.

Its molding advantage is extended flow at low temperatures, fast cure at high temperatures.

It is available as a molding compound, liquid resin, varnish, cement.

Phenolic adhesives

Resorcinol-formaldehyde is used primarily as a room setting adhesive in laminated gear blanks, laminated wood frame members for ships, therapeutic appliances.

Resorcinol resins can be used quite generally where phenolics are used. They have the advantage, in products for which they are fit, of providing excellent resistant to outdoor exposure. Also, they may be cured at a low temperature which is important in the lamination of heavy structures with thick sections.

They are available as solids or liquids.

Casting compounds

Cast phenolic is popular for baby's toys, juke box housing parts, marble-like pen bases.

Functionally, this cast phenolic material has the same advantages and requires the same care as the molding compounds. It is rigid, strong, dimensionally stable, heat resistant, hard and scratch resistant, water and chemical resistant, odorless, tasteless and nontoxic, non-flammable and light in weight.

Colorability distinguishes cast phenolic from molded phenolic. Cast phenolic can be produced in a full range of transparent, translucent and opaque colors, and in such variegated patterns as onyx and marble.

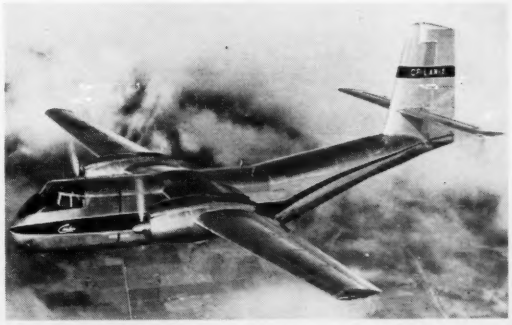
It is available in sheets, rods, tubes and special shapes.

Polyesters

Information supplied by
Naugatuck Chemicals

Polyesters are thermosetting materials. They are produced as liquids, dry powders, premix molding compounds, and as cast sheets, rods and tubes. Our basic considerations will be with the resin form. Polyester resins are a family of plastic materials supplied to users in liquid form. The addition of a catalyst and the application of heat will cause a polyester to thermoset (or cure) to a hard infusible solid, or the hardening process can proceed at ordinary room temperatures when a "promoter" is added to the resin prior to the introduction of the catalyst.

Most applications combine polyesters with some reinforcing material, most frequently fibre glass, to create reinforced plastic products. A negligible volume of polyester resins is used by itself for potting biological speci-



The De Havilland Caribou has over 100 reinforced plastic parts.

continued ▶

mens, encapsulating electronic components, etc. The information which follows will deal with polyesters in reinforced plastics.

Properties of polyesters

The properties of polyester laminates have a fairly wide range, depending on these factors: 1. type of polyester resin; 2. fillers and other additives in the resin; 3. promoter and catalyst system employed; 4. type of reinforcement; 5. construction of laminate.

The molder or fabricator, in a very real sense, manufactures his own raw material in making his product.

Generally polyester laminates are light weight, exceedingly strong, dent-proof, resistant to a wide range of chemicals, thermal and electrical insulators, and relatively unaffected by aging.

Each resin manufacturer offers ten or more basic resin types. In addition, many resin manufacturers also offer a variety of formulations of these resins, such as colored shell coatings for high-gloss exterior finish layers, thixotropic resins to prevent run-off in making boats and other large items, or rapid curing resins for faster production. There is a similarly wide selection of forms of glass reinforcement. The result is that an almost endless number of combinations of resins and reinforcements is possible.

Housing and knobs in this underwater diving equipment are pre-mix molded polyesters.

The engineer can accordingly design for a given tensile strength at the lightest possible weight, the smallest possible cross-section, or the least possible cost. Other properties, too, can be varied in the same way. Finally, he can design his laminate to give that compromise which, within the limits of available materials and knowledge, represents the best choice for his particular needs.

Methods of molding

There are three basic methods of molding reinforced polyester products: 1) Hand lay-up, including variations such as vacuum bag, pressure bag, and spray techniques; 2) Preform molding; 3) Premix molding.

Molds are more expensive for preform and premix than for hand lay-up. Speed of production and number of parts which may be obtained during the life of a mold are greater for preform and premix. Premix gives relatively low strengths, however, generally not exceeding 10,000 psi tensile.

Hand lay-up is most suitable where parts are large or where quantity is small, such as swimming pools or boats. Preform is preferable where quantities are moderate to large and the size is within the limitations of available presses. Premix is the method where great strength is not needed, sizes are small to medium, and quantity is relatively large.

Typical applications

Boats, bus and truck parts, translucent sheeting, custom-made corrosion equipment, aircraft parts, planters, chair seats and backs, electrical parts, and toys.

Polyolefins

Information supplied by
Union Carbide Canada Limited
Chemicals and Plastics Division
and
Canadian Industries Limited

The commercially significant polyolefin plastics are thermoplastic resins produced by polymerizing ethylene or propylene. Polymerization of thylene either at high temperatures and exceptionally high pressures or at lower temperatures and pressures in the presence of catalysts yields a broad spectrum of polyethelene resins. Polypropylene is by polymerization of propylene at moderate temperature and pressure in the presence of selected catalysts.

Certain properties are common to all commercially significant polyolefin plastics. All are white, translucent, tasteless, odorless, nontoxic and light in weight with outstanding dielectric properties, even at extremely high frequencies, and very low rates of water vapor transmission, even in thin films. All the polyolefins resist degradation by common mineral acids, alkalis and most other inorganic chemicals. They vary, however, in mechanical properties and in degree of resistance to gasoline, oils and organic solvents.

Differences in mechanical properties between commercial polypropylene plastics are slight and for the purposes of this article they may be regarded as one material. There is, however, considerable variation in mechanical properties between different members of the polyethelene family depending on their average molecular weight, molecular weight distribution and molecular structure—all of which are determined by manufacturing conditions.

Increasing the density of polyethelene increases such structural properties as stiffness, yield strength, tear strength, softening temperature, and resistance to organic solvents but decrease impact resistance and flex endurance. Increasing the melt index improves processing characteristics but reduces tensile strength, tear strength, impact resistance, resistance to environmental cracking and flexibiliy at low temperatures.

Polypropylene is the lightest of all plastics and surpasses any of the polyethelene in rigidity, hardness, ten-

sile strength, yield strength, abrasion resistance, resistance to deformation at high temperature, and resistance to organic chemicals.

Applications

The largest single application for the polyolefins up to now has been packaging film, in which the lower density materials have been used almost exclusively.

Polypropylene film is clearer and glossier than polyethelene film and is stronger, particularly at high temperatures. It has the advantage of being sufficiently stiff to be handled on high-speed overwrap but lacks the soft "feel" which has been such an important factor in the success of low density polyethene film in its existing markets.

The dielectric characteristics of low density polyethelene have made it an excellent insulating and jacketing material for a wide variety of wires and cables.

The market for lightweight, noncorrosive, cold water piping is still dominated by the lower density polythenes whose flexibility makes for ease of handling and installation. There is, however, an increasing demand for pipe made from higher density polyethelene for applications involving either elevated temperatures, higher pressures or both. Polypropylene piping appears promising for high pressure industrial use and for hot water plumbing.

The familiar lightweight, unbreakable "squeeze" bottle, so popular for cosmetics, medicinal sprays, adhesives and other household products because of its controlled dispensing action, is made from low density polyethelene.

The houseware and toy field embraces numerous polyolefin items and the choice between different members of the polyolefin family will be dictated by considerations of design, price and consumer preference.

Because of its high strength, rigidity and superior heat resistance polypropylene has been able to capture new markets not open to other polyolefins. These include sterilizable hospital ware, dinnerware, steam vaporizer bodies, washing machine and dishwasher components, luggage and small bookcases. Polypropylene may also be extruded into strong, lightweight, abrasion-resistant filaments which may be woven into outdoor furniture webbing and automobile slip covers or made into rope having very low stretch under load which is particularly popular for marine use because it floats.

Polyethylene was used for both the unbreakable garbage can and the home vaporizer.

Property	*ASTM Method*	*Polyethylene*			*Polypropylene*
		Low density	*Medium density*	*High density*	
Density	D792	0.910-0.925	0.926-0.940	0.941-0.965	0.90-0.91
Tensile strength, psi	D412	1000-2300	1200-3500	3100-5500	4300-5700
Elongation, %	D412	90-650	50-500	15-100	250-700
Mod. of elasticity, tensile, psi	D412	17000-35000	25000-55000	80000-150000	130000-200000
Impact strength, Izod, ft.-lb./in. notch	D256	>16	0.5-5.5	1.5-12	0.6-6.0
Thermal conductivity, 10^4 cal. per sec. per sq. cm. per °C. per cm.	C177	8.0	—	11-12.4	3.3
Specific heat, cal. per °C. per gm.	—	0.55	0.55	0.55	0.46
Thermal expansion, 10^{-5} per °C.	D696	16-18	—	11-13	11
Heat distortion temp. at 66 psi, °F.	D648	105-121	120-150	140-180	210-230
Dielectric strength, shorttime, volts/mil	D149	460-700	500-700	450-500	750-800
Dielectric constant at 10^6 cycles	D150	2.25-2.35	2.25-2.35	2.25-2.35	2.0-2.1
Dissipation (Power) factor at 10^6 cycles	D150	<0.0005	<0.0005	<0.0005	<0.0005

Comparison of physical properties of some of the polyolefin plastic family.

continued ▶

Silicones

Union Carbide Canada Limited
Bakelite Division

Silicones are a special class of semi-inorganic materials, uniquely combining the advantages of inorganic stability with organic versatility. The most striking characteristic of the silicone family is an indifference to environments too severe for organic materials. For example, the same silicones that perform reliably in sub-zero conditions also remain serviceable at elevated temperatures. The retention of electrical insulating properties, water repellency, resistance to oxidation and the effects of weathering, corona and chemical attack are important work-a-day characteristics of silicones.

Properties of silicones

Heat resistant. Silicones exhibit high heat stability. Silicone insulation has shown itself highly stable up to 590 F. depending on whether it is used with glass fiber, mica, asbestos.

Electrical qualities. Silicones have very good dielectric properties particularly after exposure to moisture and elevated temperatures. They offer a low power factor over a wide frequency range.

Chemical and water resistant. Silicones are water repellent, weather resistant and highly resistant to mineral acids, corrosive salt solutions.

Forms available

Silicones are available as molding compounds, resins, coatings, greases, fluids and as silicone rubber.

They may be made into finished articles by: *Compression, transfer, extrusion molding. Coating, calendering, impregnating, laminating, foaming, casting.*

Silicone compounds

Supplied as silicone rubber compounds and gum stocks, the latter for those who wish to do their own compounding. These silicone rubbers, mixed with inert fillers and catalysts in varying proportions, produce silicone compounds for curing into elastomer molded parts, cable and wire extruded coatings, tapes, gaskets, etc. Their outstanding end properties are: flexibility at very low temperatures, thermal and oxidation stability at very high temperatures, extremely low compression set, ozone resistance, non-sticking characteristics, resistance to outdoor weathering, good electrical and oil resistance.

Silicone intermediates and monomers

Of fast-growing importance in the paint industry, silicone intermediates add remarkable properties to protective coatings under extremes of atmospheric conditions. Primarily designed for the modification of organic resin systems, they utilize the outstanding properties of both organics and their own inorganic basic structure in a single composition. Products for this purpose, in general, are silicone polymer intermediates containing reactive groups for polymerization with organic resins. Can be cold-blended with a variety of organic resins. Typical end products are long-lasting aluminum-pigmented stack paints; flexible glass-tape impregnants, abrasion- and solvent-resistant electrical insulating varnishes.

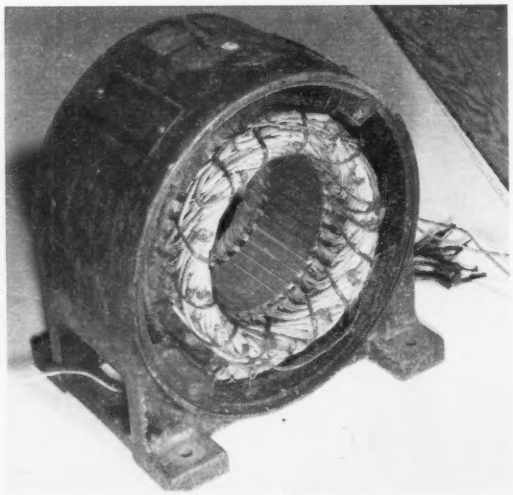
OrganoFunctional Silanes are unique chemical intermediates which undergo the classic organic reactions.

Silicone Monomer. Speedily applied finish for heat desized glass cloth used in glass-polyester laminates to provide high wet-flexural strength, often exceeding dry strength.

Silicone Grease. Specifically developed for dependable bearing lubrication of electric motors operating under Class H conditions. Its general inertness and long life also make it useful as a permanent lubricant for other applications.

Typical uses

The big outlets for silicones are in the electrical industry where they are used for coil forms, switch parts, induction heating apparatus, as insulation for motors and generator coils, in power cables.



Silicone materials are frequently used for motors, generators, transformers, etc., because of their electrical, thermal, water-resistant and non-oxidizing properties. They solve many problems. This class H generator, for instance, which uses silicones as the insulating resin, was designed for double-decked coaches for a railroad line. The unit is no larger than those used previously, but it supplies sufficient power to meet greatly increased demand plus overload conditions.

Styrenes

Information supplied by
Dow Chemical of Canada Ltd.

The types of polystyrene available today can be divided into three general groups. The first of these groups comprises the polystyrenes which have not been changed by the addition of modifiers.

The second group includes the shock-resistant or impact types of polystyrene. The physical properties of these materials have been altered considerably through the use of modifiers.

The third group includes chemical-resistant materials. These are copolymers of styrene with some other monomer especially formulated to increase the chemical resistance of the end product.

Physical properties of styrene

In discussing physical properties of styrene, it should be repeated that plastics are engineering materials. They exhibit the same properties as do metals. Stress-strain curves can be plotted for them. They are subject to distortion due to heat. They stress crack, and they creep much the same as do metals.

One of the most obvious and important differences between plastics and metals is the range of temperatures, pressures and conditions over which these physical changes occur. Although tensile strength and modulus of rigidity for steel and polystyrene are in different ranges, for instance, the behavior of the two materials in tension is similar.

The effects of temperature, aging, and other environmental conditions upon the physical properties of polystyrene are of critical importance in mechanical design. These effects are being studied and tabulated in laboratories and through actual performance records. Plastics are relatively new engineering materials and they do not have the benefit of the long history of wood for example. However, a considerable amount of information is available from the manufacturers.

Forms and methods of fabrication

Normally these materials are supplied in pellet form which can be easily handled, has good bulk density and can be charged directly into the injection molding machine, compression press or extruder for the production of finished parts or components

In addition impact grade sheet materials can be purchased from converters and made into finished parts by vacuum or pressure forming. A wide variety of extruded shapes, blocks, tubing, etc., is available from specialized suppliers for use in small production runs, prototype or model making.

The polystyrenes can be machined, mechanically finished by grinding, tumbling, or buffing and polishing and can be decorated by painting, printing or vacuum metalizing. Parts can be joined by solvent welding, special adhesives or heat welding.

Recently, expandable pellets or beads of high heat general purpose polystyrene have been made available to the trade. These are prefoamed to the required density by the fabricator and fused together to form a foamed article in a heated, low-pressure mold. Foamed polystyrene in the form of boards, plank or logs is also available from some material suppliers.

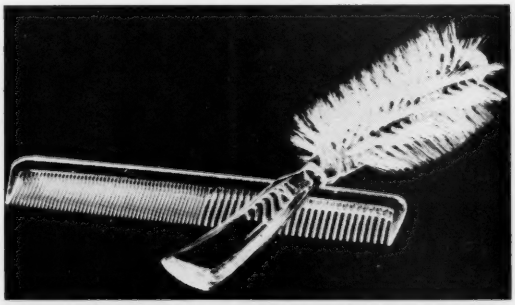
Crystal-clear, biaxially oriented polystyrene film is available for applications requiring a low-cost, high-clarity film with medium toughness. Shallow draw parts can be vacuum formed from this material.

Typical uses

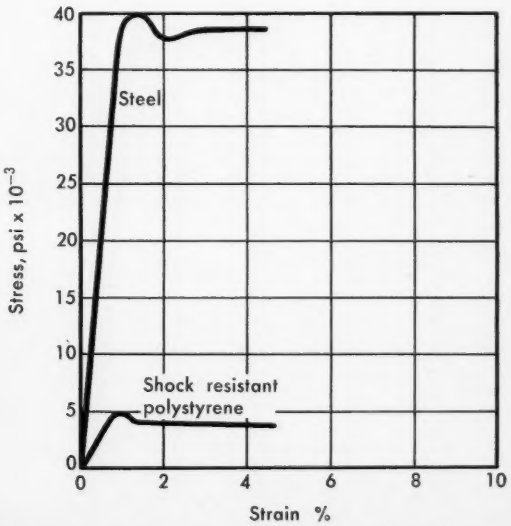
Typical applications of general purpose materials include wall tile, food containers, rigid packages, brush backs, pharmaceutical containers, and hundreds of others. The high-heat materials are used extensively for radio cabinets, coil forms, and dial faces and applications which require a minimum percent of volatile ingredients

One of the largest applications for shock-resistant polystyrenes is innerdoor liners for refrigerators. Other large-volume applications include toys, radio cabinets, battery cases, drawers, containers, furniture drawers, storage bins, flashlight cases, and household appliance housings.

Some typical uses for chemically resistant types



Styrene was chosen for this brush and comb set because of its optical clarity, good moldability and strength.



Stress strain curves for steel and shock-resistant styrene.

continued

include drinking tumblers, oil filter bowls, medical equipment components, and refrigerator parts.

The light stabilized polystyrenes are used primarily in the fluorescent field for grids and diffusers on fixtures and luminous panels or ceilings.

The copolymer of styrene and methyl methacrylate is used in appliances, automotive, signs, decorative lighting fixtures, film, etc.

Foam applications

The properties of foamed polystyrene suggest many applications. Its low thermal conductivity, light weight, and low water absorption make it an ideal material for insulation purposes. Quick and easy methods of installation have been developed to add to its desirability as an insulation material.

It is also used extensively in buoyancy applications. Many aluminum inland water boats use foamed polystyrene as a buoyancy agent.

Expandable polystyrene is used extensively in sandwich construction. The foam is used as a core between facings of many different types of materials including metals, plastics, and wood.

Foamable beads are used to mold attractive functional packages where both the insulation value and cushioning characteristics have been put to good use.

Urethanes

Information supplied by
Reichhold Chemicals (Canada) Ltd.

Industrial interest in urethane plastics, in this country, has grown rapidly during the past two years. These versatile materials have been used for some time for a wide variety of purposes and in many different forms such as moldings, castings, flexible to rigid foams, sheets, films, coating, adhesives and bristles.

Properties

Tough and shock resistant. These plastics can be produced with varying degrees of hardness combined with toughness and are remarkably shock resistant. Elastomeric types have unusual abrasion and tear resistance properties. Foams in a like manner show many of these characteristics besides exhibiting shock-absorbing, heat-insulating and sound-proofing qualities. They are light weight and available in various colors.

Adhesion. Urethanes are outstanding in their adhesion to a diverse list of materials such as those already mentioned above for coatings. They are among the few substances effective for adhering synthetic rubber to synthetic fibers in the manufacture of tires, and for uniting rubber with metals and ceramics.

Resistant to chemicals and other agents. The cured plastics are remarkably resistant to a wide variety of deteriorating agents such as many of the common chemicals, including organic solvents, and petroleum products such as transmission oils. They are highly water and moisture-resistant and rot and vermin-proof. By incorporating specially compounded polyesters, they can be rendered flame-resistant and can be made to withstand wide changes in temperature.

Cure. They can be fabricated and cured at either room or slightly elevated temperatures.

Forms available

Urethane plastics of different forms are manufactured by causing polyisocyanates to react with compounds containing two or more hydroxyl groups, such as polyesters, polyethers, castor oil, epoxies, and the like. Small amounts of water are incorporated in the reaction mixtures to generate carbon dioxide in the fabrication of foamed products.

Fabrication is generally carried out starting with the two reactants, polyisocyanate and polyol. These raw materials are supplied as liquid or solid organic isocyanates, and as special polyesters and polyethers produced for this purpose, or as prepolymers (partially reacted polyisocyanates with polyols). Catalysts, coloring agents and other modifying agents are added during fabrication.

They are formed into end products by molding, casting, extrusion, spinning and coating.

Typical uses

Urethane foams are favored for cushioning, mattresses, insulated clothing, padding, certain toys, packing, rug underlays, sponges, mats, crash pads, and light-weight structural parts of many types.

Solid articles formed by molding, extrusion or casting include printing type, elastic rolls, abrasive wheels, cable insulation, bristles, tire treads, and airplane structures.

Urethane coatings impart outstanding protective and decorative effects to wood, metals, rubber, textiles, concrete, paper, leather, plastics and other products.

Density lbs per cu. ft.	1½	2	2½	3½	5½
% Shrinkage upon foaming	Nil	Nil	Nil	Nil	Nil
Cellular structure	Med-Reg	Med-Reg	Reg-Fine	Reg-Fine	Reg-Fine
% Closed cells	85	89	88	90	90
Tensile strength, psi	50	78	89	140	158
Compressive strength, psi to 25% defl.	17.5	36	38	74	136
psi to 50% defl.	19.4	37	42	77	170
Water absorption, lb/per sq. ft. of surface area, 60 hr. immersion, after blotting of surface water	.05	.05	.05	.04	.04
Heat distortion, % defl. from 100 gm/per sq. in. load, 24 hr. at 150° C	59	54	51	28	18

Table of physical properties of a typical family of polyurethane foams.

Vinyls

Information supplied by
Monsanto Canada Limited
Toronto

The vinyl resins, both homopolymers and copolymers, can be divided into four groups:

1. General purpose: Includes resins used in injection molding, extrusion, and calendering.

2. Dispersion resins: This group is used in the preparation of plastisols, organosols, and modified plastisols. Formulations based on dispersion resins are used for fabric coating (with knife or roller), dip coating, foams, and rigid shapes cast from plastisols containing a polymerizable ingredient.

3. Vinyl resins latices: Vinyl polymer or compolymer resin particles in a colloidal suspension in water. They are designed primarily for coating, impregnation, and saturation applications.

4. Soluble resins: Copolymer resins specially designed for high solvent solubility for use in lacquer type coatings.

The choice of the proper resin or combination of resins is usually left to the raw material supplier when a compound is designed for a particular application. Vinyl compounds are available in a complete range of properties from highly flexible and resilient forms to tough rigid materials which find a variety of uses. They can be easily worked on conventional thermoplastic processing equipment into a variety of forms and shapes to meet the requirements of product design and function. Unlike many of the other thermoplastic materials, however, the formulation of a vinyl compound is a design problem in itself.

The choice of resin is dependent upon the process which is to be used in forming the final product. Rigid compounds require the use of low specific viscosity resins to allow processing within a practical temperature range and on normal processing equipment. Formulations for spray, roller, or dip coatings are based upon dispersion resins which, when combined with the necessary modifying ingredients, yield fluids of varying viscosities, depending upon the requirements of the methods of application. After application these dispersions can be cured by the application of heat into continuous films with properties based upon the formulation. Dispersion resins also form the basis for the production of vinyl foams.

Vinyl compounds, whether they are prepared via extrusion, calendering, molding, plastisol, or latex process, are usually modified in order to achieve the desired end properties. Stabilization is necessary to protect the resin from the effects of heat and light and the next modification usually is the use of plasticizers to achieve the desired degree of flexibility.

Fillers, as the word implies, are inert materials used to control cost, processing characteristics, and certain physical and electrical properties. The use of carefully selected filler materials improves the electrical properties of flexible vinyl compounds. Similarly, the particle size and type of filler will affect the surface finish and appearance of the fabricated article.

The full range of potential vinyl compounds is much too great to cover here but it should be borne in mind that vinyl can be tailored to meet a great variety of applications and that technical assistance is available to the design engineer from the raw material suppliers who are only too pleased to give assistance in solving design problems.

	Medium sp. viscosity resin	*High sp. viscosity resin*
Specific gravity	1.305	1.302
Tensile strength, psi	1640	2110
100% modulus, psi	680	900
Ultimate elongation, %	375	360
Durometer A hardness	75	76
Flex temperature °C	- 52	- 51
Brittle temperature °C	- 57	- 58

Properties of general purpose vinyl resins.

Forms available

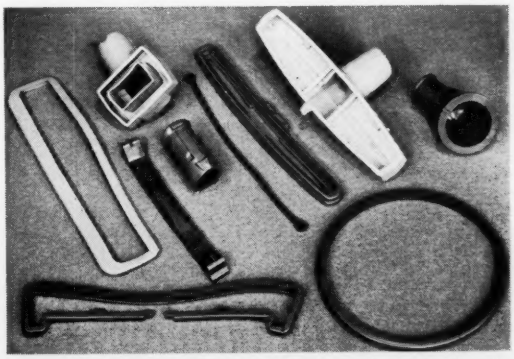
Vinyl resins are available as dry free-flowing white powders. Specific properties and particle size range depends upon the particular type of resin.

Compounded vinyl materials are available as flexible film, flexible sheeting, rigid film and sheeting, pelletized compound of extrusion, injection molding and compression molding, plastisols and organosols.

Typical uses for vinyls

Vinyls have found a myriad of applications. These run all the way from pipe to clothing, and include light diffusers, tanks and ducts, eavestroughing, upholstery, refrigerator gaskets, automotive grease seals, door sills, moldings for toys, and all forms of foams.

Vinyl polymers and copolymers find also extensive use in vinyl-asbestos floor tile, sheet flooring and phonograph records.



Vacuum cleaner parts made from vinyl resins by the injection molding process.

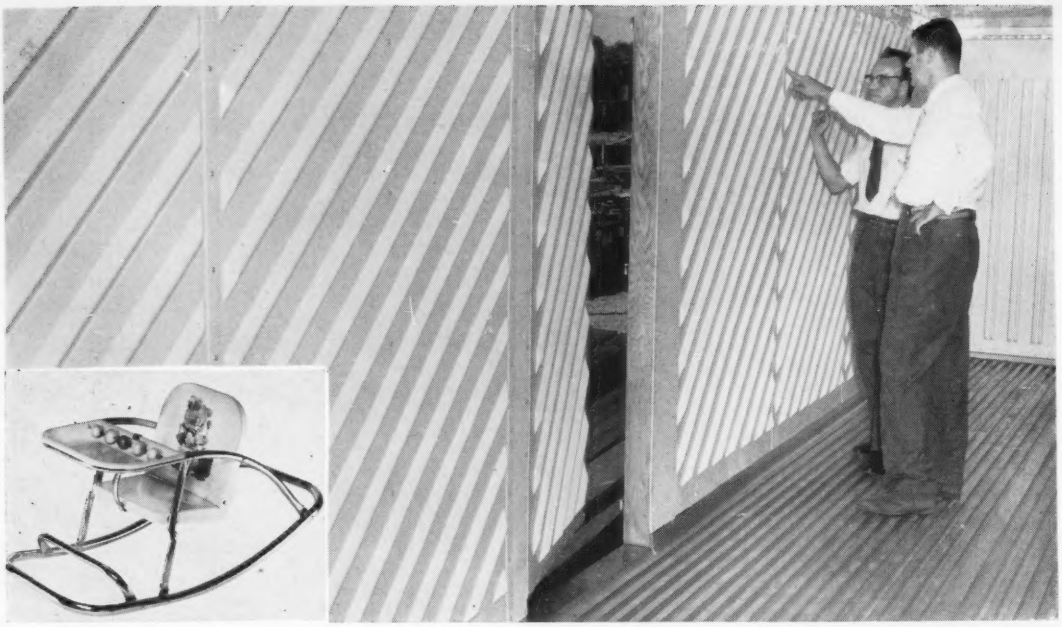


Fig. 1: Vacuum forming lends itself to the largest and the smallest. Here is the interior of a Can-Car trailer showing vacuum-formed liners. Inset, the baby rocker's tray is vacuum formed in high density polyethylene.

Vacuum forming: aid to cost reduction

Considerable saving in time, too, as these case histories show

J. P. Pritchard
G. M. Plastics Corp.

The conscientious design engineer today is faced with many problems before his final product or part becomes a sales item. On the one hand, he must meet the exacting demands of industry or the modern consumer and on the other, he must consider the potentialities of a multitude of materials and production techniques. As each year passes, the problems become more complex; new materials and processes are developed and the market becomes more competitive.

To find a reliable shortcut to the many decisions that must be made is not easy. Designers want facts. They need proof. The vacuum forming industry is in a position to give both.

Help for the designer

Specifically, the vacuum forming industry is in an ideal position to help the design engineer where thermoplastics are involved. Before elaborating on these services, please refer to figure 2 which gives a very simple idea of the vacuum forming process. It is not necessary here to detail the many variations such as drape forming, plug assists, bubble forming, snap back, pressure forming and the advantages of male and female molds. As long as the design engineer has the general idea of the process and knows that the industry will give him all the additional help necessary, he should have no concern about thinking in terms of vacuum formed pieces or parts.

In the past, there has been an inclination to copy competitive products, specially with regards to raw materials used. The surest way to obtain a portion of an established market is to bring out an almost identical product at a competitive price. True, slight modifications are usually incorporated in an attempt to lower the price, usually only slightly. In this case, the designer's job is comparatively easy. In a competitive market however, the best he can hope for is about half the total potential if he is the second producer, a third if he is number three and so on.

Assume the competitive product is a light gauge steel, formed cabinet. There are three large volume sizes and three small volume sizes involved. Having completed the design he must now become committed to the die costs. These will be several thousand dollars each. As usually happens, he cannot afford to speculate in dies for the other smaller volume sizes, a situation characteristic of the Canadian market. Once the dies are made, design changes are difficult if not impossible, and it is not until they are made that he has a good representative sample. Time too is a factor. Tooling for metal often runs several months.

Let's look at the areas of saving. A reliable vacuum former will make an effort to assure himself that an application has potential for his process simply because development costs money. If it does not, he will recommend other processes if he believes they can be of help.

The choice of materials is usually left to the discretion of the vacuum former when quoting, although this is not always true. The type of tooling required is similarly treated. At this point the designer will find that the plastic pieces are very often quite competitive. Naturally there is no hard and fast rule in this respect.

The big difference comes in tooling. Vacuum forming molds are often one tenth the cost of sheet metal tooling, or even most other types of plastic tooling. The designer realizes now that the complete line can be tooled up, still at a very great saving. There is a possibility too that special sizes could be considered.

Before examining a few specific cases there is one other point that should be made clear. Plastics in their proper applications are not inferior replacements for other materials. They often out-perform the materials they replace, or have characteristics that actually make the special application possible. To not consider them often means finishing up with an inferior product.

Sample applications

In some cases, initially they are more expensive but in the long run they prove to be a saving. Take, for example, refrigerated trailer body inner liners. Canadian Car Company Limited in Montreal are one of the leaders in the construction of these "Reefer" trailers. The plastic liners, 48 in. x 96 in., have formed-in ribs to increase cool air circulation. The plastic used is Cycolac, a tough, very low moisture absorbtion material, with a shiny surface. The plastic liners are replacing plywood in trailers used mainly for the shipment of fresh meat. In the past, wood panels have often splintered and the meat has picked up the slivers of wood. Cleanliness was a problem too, as the plywood picked up moisture and blood and retained odors. Cycolac panels by comparison are easy to clean, do not pick up odors, do not splinter, do not affect the fresh meat in any way.

For these savings plus a saving in weight, Can Car's customers pay an initial premium of $1,200 per trailer, but make it up in the long run. This, then, is a vacuum formed plastic application with higher initial cost, long run savings, greater performance and higher quality.

Mr. W. Stanley, at Victoria Precision Works Co. Ltd., who are experts in metal forming, is using a high density polyethylene vacuum formed tray on Victoria's baby rocker. The piece price in plastic is 18-20% over the metal piece price. Tooling, however, was $200 for plastic compared with $2,000 for metal. Mr. Stanley points out other advantages. No sharp edges, durability of finish with solid color, plastic washability, and in case changes are necessary, the flexibility of making mold changes at minimum costs.

Fortune Associates, who have designed many vacuum formed parts, used this process to advantage for the Bain & Bowes towel rack cover made for Canada Paper. This part was considered in metal, however, the deep draw was a problem. The vacuum formed part solved this problem, at an overall saving in cost.

The above case studies are examples of why vacuum formed plastics are finding so many new applications.

The list is very long, but if each application could be closely investigated the design engineer would see a familiar pattern emerge — lower initial, short term, or long term costs, together with high performance and quality. ★

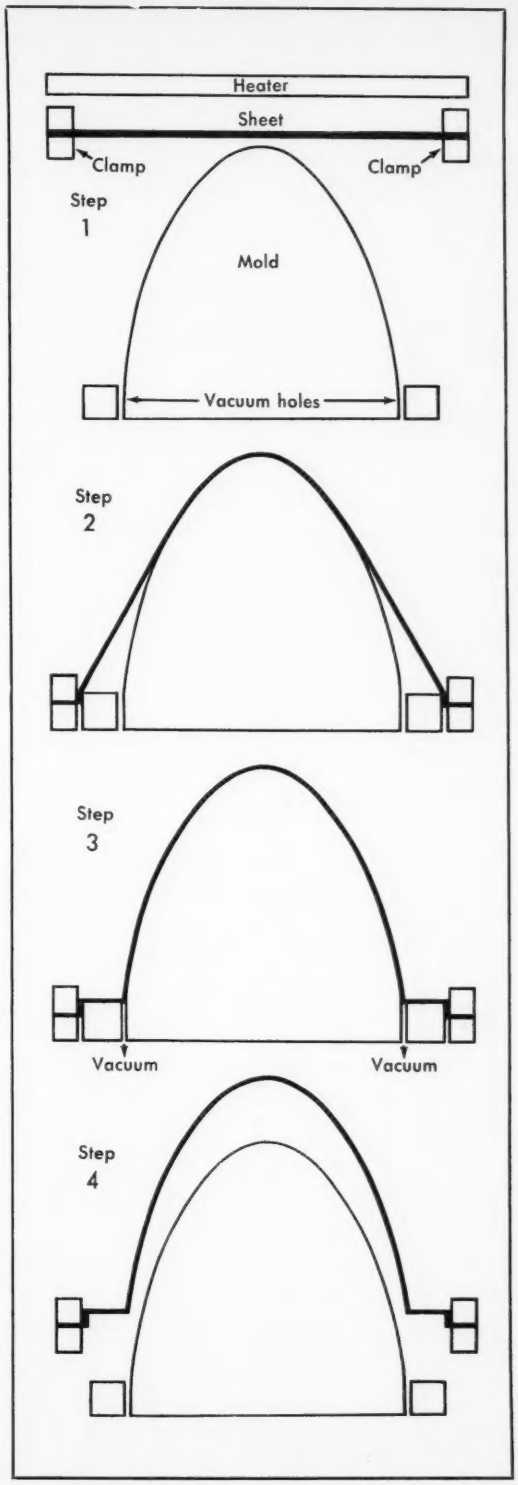


Fig. 2: Four stages in vacuum forming. (1) The plastic sheet is clamped in a frame and heated over the mold. (2) Heater is removed and frame brought down. (3) The vacuum is turned on, drawing the sheet to the mold. (4) The finished piece is lifted off the mold.

A design profile

George Harry
Assistant Editor

Double Diamond scores a strike, edges out American competition

New equipment designed by Sid Bersudsky cuts cost of manufacture and installation

Double Diamond is one of Canada's two principal manufacturers of bowling equipment in an industry dominated by two giants. But though a major producer, this all-Canadian company was for a long time "low man on the totem pole as far as equipment was concerned."

The phrase comes from Sid Bersudsky, one of the country's principal industrial designers. It's a phrase he delights in using now, because Bersudsky himself has just put Double Diamond very high on that self same totem pole.

The line of bowling equipment he designed for Double Diamond represents, again in his own words, a complete breakthrough in an industry steeped in tradition. He attributes this breakthrough, interestingly enough, partly to the fact that neither he nor his colleagues at Sid Bersudsky & Associates were really bowlers when they tackled the assignment.

"It was also my first work on any sort of sporting equipment," he says, adding, "I'm not in any way athletic."

Had Complete Freedom

They began the assignment with certain terms of reference but almost complete freedom to do what they liked. The first step was to learn something about the game itself, though even now Bersudsky doesn't claim to be a regular one-night-a-week bowler.

"My lack of experience meant that I came to the assignment with no preconceived ideas," he says. "Nor was there any question of adapting other people's ideas."

He doesn't talk much about the evolution of the new equipment, but as a novice bowler he must have been forcibly struck by the clatter of the returning ball. This noise was to be one of the problems he had to eliminate.

As everyone knows, the ball returns on a wooden track; thus the return could scarcely be noisier. If that weren't enough to offend the aesthetic Mr. Bersudsky, embedded in the wood are two strips of vulcanized rubber molding.

"Look at it," said Bersudsky, producing a section of track from the pre-Bersudsky era. "Besides being expensive to make, it's just a mess from the production engineering standpoint."

He then flourished a piece of Double Diamond's new track. It's an aluminum track with an aluminum extrusion. A polyethylene extrusion snaps firmly onto this extrusion.

Why Two Extrusions?

"Ask me why we didn't use polyethylene without the aluminum extrusion," invited Bersudsky, then explained without allowing time for the question: "Because the aluminum extrusion gives greater strength and rigidity."

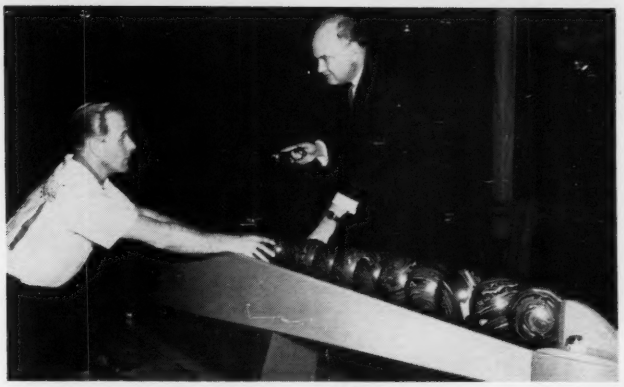
There are other benefits. Maintenance is easier and the equipment can be supplied in any color — aluminum and plastic both.

Though Bersudsky's terms of reference were fairly broad, costs had to be watched. The cost factor is clearly perceptible in the ingenious bench units. The bench consists of five chair units joined together; thus one mold produces either bench or chair.

Admittedly this is scarcely a unique idea, but where Bersudsky "breaks through" again is in the flexibility of the bench arrangement. Is space a problem in the alley? A straight bench can be installed. Is there room (or need) for a curved bench? The same chair units form into a half circle by the simple expedient of reversing them; in other words, making the seat the

Seats and backs reversed, a straight bench —

Pretty model demonstrates prototype score stand at recent Sportsmen's Show in Toronto.



Sid Bersudsky (right) and Don Walker, secretary of the Ontario Bowling Association, study the prototype of the new Double Diamond equipment.

back and vice versa. Is an L-shaped bench needed in that corner? The same flexible units will obligingly form into the required L-shape.

No Design Indulgence

This flexibility of arrangement, let it be added, is no design indulgence. The important point is that one die (the component is fiberglass) serves instead of three. Moreover the same die produces single chair units, not necessarily for bowling alleys but for other applications. However, Bersudsky is not talking about these just now.

The other units in his new line are the score stand (unusual cantilevered design, swing out chairs, sloping writing surface); ball return unit (the bowler's fingers are safe here, the unit is a convenient height for easy pick up, and again there is no clatter); underground ball return (the same features as in the regular return stand); and the masking unit (pleasant, no-glare lighting plus considerable electronic ingenuity in masking the automatic pin-setter).

But Bersudsky's pride and joy is quite clearly the track, which he seems to favor even more than the ingenious bench units. A business paper editor who called for details about the bench was given a strong pitch for the track instead.

What do these new designs achieve? Bersudsky ticks off the points as follows:

- Better appearance;
- Reduction in cost, both of manufacture and installation;
- Greatly improved function;
- Elimination of noise;
- Less abrasion on the bowling ball, which will probably last longer now, though there hasn't been sufficient time to test this point.

The cost factor he regards as the most important. This equipment, he says, gives Canadian industry the opportunity to compete successfully with equipment from the United States.

Export Prospects

"Not only that," said Bersudsky, "but it will be able to compete in the export market, which is very important for us. Most Canadian manufacturers copy (or shall we say adapt?) U. S. designs. This reduces their prospects in export markets because nobody is going to buy Canadian copies of American products. Also, of course, the U. S. has the advantage of mass-production economies.

"Since we can't compete on a cost basis, we must compete — if we're going to sell abroad — on the basis of superior design and quality. We are confident that we have achieved both with our Double Diamond line."

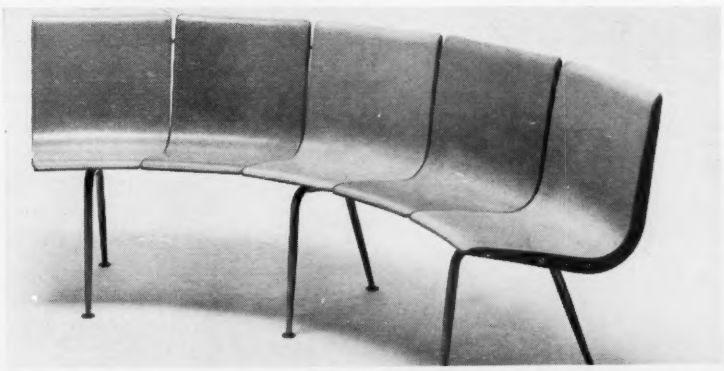
"Moreover," said Bersudsky, "this is a continuing program for Double Diamond. We are not resting on our laurels."

On the subject of copying other people's designs, Bersudsky was asked how much of the Double Diamond equipment could be pirated. He said world patents were pending and they were "trying to cover as much as possible, especially the chair and the track."

It took 15 or 16 months from the time he started on the project until the first equipment was installed in a St. Catharines, Ont., alley. The second installation was recently made in Toronto.

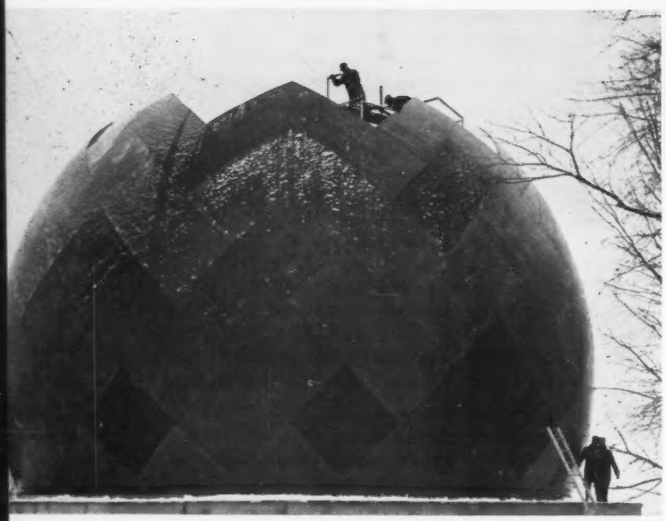
Bersudsky isn't certain if he'll enter the Double Diamond line in the next NIDC contest. "We've had our fair share of awards, you know. Besides, we get our reward in client satisfaction, consumer acceptance and a healthy bank balance." ★

— is soon converted into a curved bench

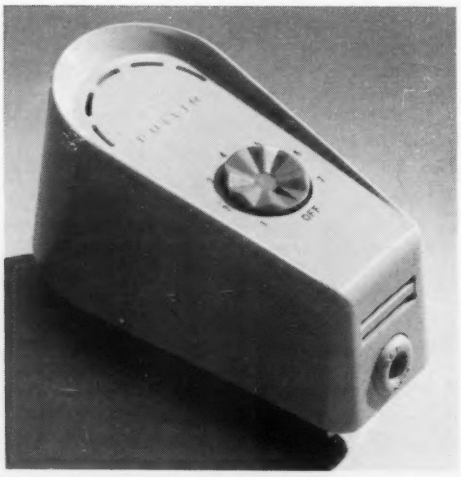


Designews in Pictures

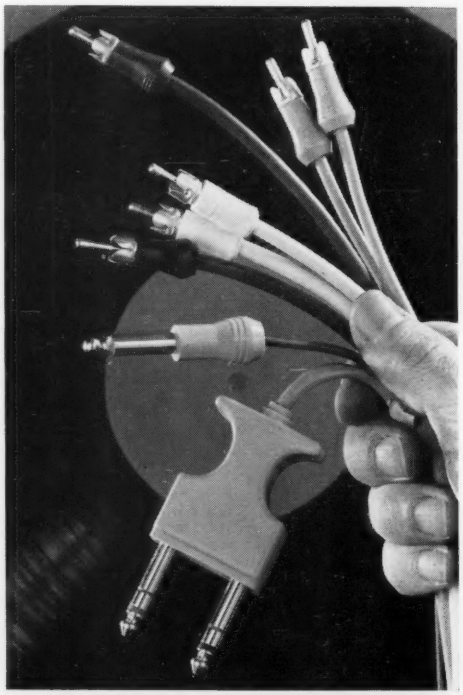
The "skirt" around the base of this "air car" used to be rubber, but it wore out almost daily from abrasions, so the manufacturers experimented successfully with a new material, a urethane produced by the interaction of diisocyanates with hydroxy polyesters or polyethers.



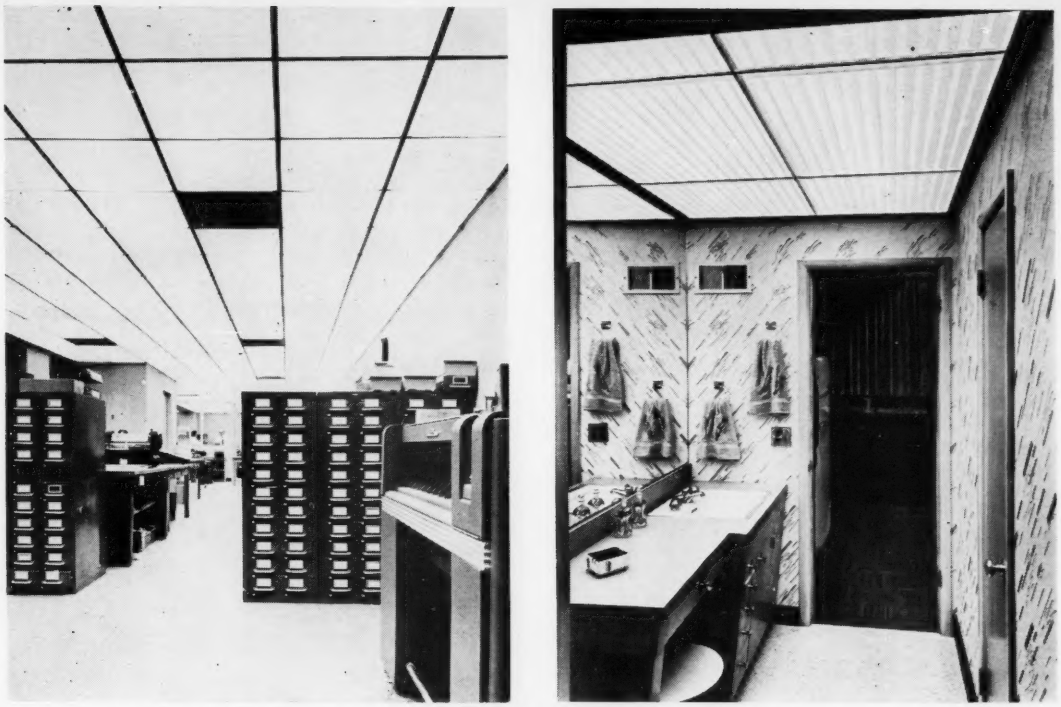
Epoxy panels were used to build this Canadian-designed radome. Forty feet high with a base diameter of 50 feet, it was erected by six men in a day and a half.



The cover of this plug-in type thermostat is molded in urea formaldehyde. A neon indicator light is fitted on the front and glows so long as the heater is connected, whether the element is switched on or off. (Photograph from Council of Industrial Design, London.)



Contoured grips molded in butyrate plastic make plugs used in audio equipment easy to handle. Light in weight, they are tough under stress of frequent plug insertion and removal.



Corrugated luminous vinyl ceiling panels create a bright, cheerful and well lighted working area. Vinyl resins impart toughness, strength, clarity, dimensional stability and high tensile strength to the sheet from which the panels are made.

Rigid vinyl sheet for lighting design

Material has many properties which allow entirely new designs

B. H. Gambrill and J. Pegram
Shawinigan Chemicals Limited

Rigid sheet manufactured from copolymers of vinyl chloride comprises a rapidly increasing proportion of the materials of construction used by the lighting industry. Consumption of vinyl sheet by this industry in the U. S. doubled between 1956 and 1959 ([1]) and the Canadian growth rate probably has paralleled that of the U. S. This growth is attributable to the inherent properties of unplasticized rigid poly (vinyl chloride-acetate) and to the significant advances in the technology of vinyl compounding, aided by an increasing awareness among lighting engineers and architects of the value and desirability of employing plastics materials in their designs.

There are numerous properties of rigid vinyl sheet which commend it to the design engineer in lighting. Probably of greatest importance are its low cost, ease of fabrication and its characteristic non-flammability. Cost figures of 15 to 35c per square foot of diffuser area have been cited recently ([1]). This compares extremely favorably with other plastics and glass. Rigid vinyl sheet is molded to the desired shapes at moderate temperatures and low pressure by vacuum forming techniques in the range of 250 to 320 F and a comprehensive discussion of vacuum forming methods suitable for molding rigid vinyl is available ([2]). City building codes relating to the use of flammable materials of construction underscore the importance of the non-flammability of vinyl sheet.

Other characteristics of rigid vinyl which commend its use are its dimensional stability through wide variations of climatic conditions, its high tensile strength and modulus of elasticity, its clarity and high levels of light transmission and the variety of finishes in which it is available. Continuous development work in recent years has resulted in rigid vinyl sheet exhibiting excellent stability to light, particularly under conditions of high ultra-violet radiation, along with improved impact strength. Typical values for some of the properties discussed are given in Table 1. The creep of rigid vinyl

Continued on page 76

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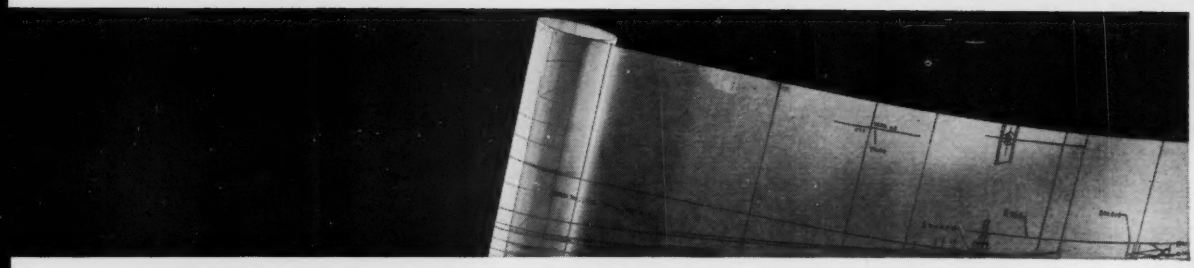

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Rigid vinyl sheet *Continued from page 73*

is negligible, flow occurring to less than 1.0% at 2,000 psi stress and 50 C. The stress acting on vinyl in a luminous ceiling installation at normal environmental temperatures will be insufficient to produce any noticeable cold flow. The relatively low heat distortion of rigid vinyl provides additional inducement for its use in luminous ceilings. In the event of fire the thermoplastic vinyl falls away from the ceiling at a temperature slightly below that necessary to activate the hidden sprinklers, thus permitting effective operation of the sprinklers.

Calendered rigid vinyl sheet is now extensively used in Canada for lighting fixture fabrication. Poly (vinyl chloride-acetate) resin is compounded to obtain an optimum combination of properties, embracing satisfactory calenderability, good sheet formability, dimensional stability, excellent light stability and improved impact strength.

Luminous ceiling designs

Sheet intended for translucent diffusers is processed to give a perfect, fine, dull mat surface, free of contamination and with consistent, even light transmission. Additionally a balance between the highest light transmission and complete screening of the illuminating source has been obtained. The sheet is available in a wide range of pre-cut sizes, or in roll form, and is generally used in thicknesses of 7 to 30 mils or 1/16 to 5/16 inches, depending on the type of lighting fixture being constructed.

The original application for rigid vinyl in the lighting industry was for rigid sheets 1/16 to 5/16 inches, hot or cold press-formed into reflectors to replace similar metal parts. Most of the rigid vinyl sheet now going to the lighting industry is used for luminous ceiling installations. Translucent sheet, forming the ceiling, diffuses the light from fluorescent lamps providing efficient, uniform illumination and eliminating glare. The sheet is corrugated or molded into pans to improve the rigidity of the relatively thin gauge material used and to provide desirable decorative effects. Pan designs are available which provide a measure of accoustical control, as well as serving their primary function of illumination. A second clear sheet of vinyl may be sealed to the translucent, forming a hermetically sealed air-spaced unit. This second sheet provides additional rigidity and prevents the accumulation of visible dust on the lower sheet. Several designs of this type are available, one of Canadian design and manufacture is proving to be particularly successful ([3]).

In this latter case the upper transparent sheet is recessed to contain the fluorescent tubes; the sides of the unit are mat opaque white, reflecting light through the translucent sheet which forms the ceiling. The whole unit is hinged, swinging down to permit easy cleaning.

Lamp-to-plastic distance and type of lamp is important in designing luminous ceilings in plastics materials. The greater this distance the longer will be the service life of the units. A lamp-to-plastic distance of three inches or more is considered desirable to prolong the useful life of the plastics, although distances down to one inch might be used successfully. The aging of plastics exposed to fluorescent lamps varies markedly according to the type of lamp. Daylight and standard warm white types have been reported ([4]) as having the least effect, soft white, deluxe cool white and deluxe warm white as having the most effect. It is possible that carefully controlled tinting of the plastics sheet forming the diffuser component can offer the variety of illumination using the single lamp type least severe in its effect on the aging of the plastics.

Table 1. Typical values for improved impact strength rigid vinyl sheet.

Specific gravity, at 25C.	1.30
Modulus of elasticity, p.s.i.	4.0×10^5
Tensile strength, p.s.i.	7,500
Impact strength (Izod), ft-b/in. of notch	1.0
Heat distortion temperature at 264 psi, deg. F.	145
Cold flow at 2,444 psi 50C, %	0.8
Linear thermal expansion coefficient, per deg. C (below 50C)	6.9×10^{-5}
S.P.I. Flammability	Self-extinguishing

Other uses for vinyl

Life of a lighting fixture fabricated from rigid vinyl sheet will depend upon the vinyl formulation, the heat history of its processing, lamp-to-plastic distance, lamp type, temperature of operation and whether illumination is intermittent or continuous.

With each of the variables requiring consideration it is difficult to estimate the life expectancy of vinyl sheet from accelerated laboratory tests. Actual service performance to date together with accelerated tests suggest a minimum service life of 5 to 10 years, with newer formulations probably in the higher values of this range.

The foregoing has discussed the suitability of rigid vinyl for a highly specific application, describing the ease of its fabrication, its desirable mechanical properties and excellent service performance. The engineer should bear in mind, however, the diversity of applications for which rigid vinyl is suited and, indeed, being employed. Rigid vinyl pipe is used in the chemical industry under extremely corrosive conditions, in sheet form it is used for chemical resistant tank linings, and profile extrusions are finding use as window channeling, to name a few of the many applications. Wherever a smooth, hard, durable and light weight material is required, rigid vinyl demands the consideration of the design engineer.

References

(1) Anonymous, "Bright Days Ahead for Plastics in Lighting," Modern Plastics 37, 94 (August 1960).

(2) Platzer, N., "Sheet Forming" in "Processing of Thermoplastic Materials" by Bernhardt, Ernest C. (editor), pp. 447-510, New York, Reinhold Publishing Co., 1959.

(3) Metcalfe, R., "Prairie-Made Bubble Throws a New Light from Ceilings," Progressive Plastics 1, 20 (December, 1960).

(4) McCarthy, R. A. and Popielski, D. A., "Evaluating Polystyrene Plastics with Improved Ultra-violet Stability for Use with Fluorescent Lighting," Technical Paper No. 57, 15th Annual National Technical Conference, Society of Plastics Engineers, Vol. V, 1959.

Briefs

Making its own small contribution to the plastics issue, this column brings you up-to-date on new developments in the field: **a U. S. magazine** is mailed to subscribers in a polyethylene bag, partly for its attention value and partly because it does a better job of protecting the contents . . . **a newly developed** protective coating made of Fiberglas has just been applied to the deteriorating hull of the Joseph Conrad to protect the famous full-rigger, now 88 years old, from further corrosion . . . **B. C. motorists** are now getting almost indestructible key tags made of polyethylene; supplied by the Disabled Veterans' Association, they are said to be cheaper than other materials, require no separate fabrication of frame and license number and will not become brittle or break in the coldest weather . . . **and in Regina** an orthopedic surgical application worker at the Disabled Veterans' Association has constructed an experimental limb made entirely of polyethylene; the limb is a leg and the inventor, Fred Tease, wears it himself . . .

And if you're eager for more news about plastics, why not attend the one-day technical sessions on "Automation in injection and compression molding" sponsored by the Ontario section of the Society of Plastic Engineers at the King Edward Hotel, Toronto, on November 7. There will be 10 papers covering process and automatic equipment, operating techniques and future developments. A major attraction will be veteran ex-NHL hockey referee "Red" Storey, the luncheon speaker. Interested? Advance registration fee ($9.00 for non-members) is through John D. Glen, C-I-L, 1303 Yonge St., Toronto.

Our Ottawa private eye reports that the government, now awaiting the Royal Commission report on the auto industry, can find part of the answer to the industry's troubles right in the capital. In the East Block quadrangle stand External Affairs Department trucks made in Britain, while from the post office yard at the foot of Parliament Hill emerge trucks made in Germany . . .

Talking of foreign imports, news comes from Detroit of a unique contract granted to a local tool and die firm. It has made 362 dies for stamping body parts used in the manufacture of English passenger cars and vans. An impractical arrangement, especially since some of the dies weigh more than 22 tons? Not at all, says the die company, explaining that the English manufacturer wanted high quality dies and rapid delivery (seven months), which he

Continued on page 78

Briefs — *continued*

couldn't get in Britain; also the Seaway's shipping economies helped to swing the deal. This is a good way of rendering imports less painful, but since Canada also offers high quality workmanship, plus the Seaway's advantages, to say nothing of the benefits of Imperial preference, we feel justified in asking if the customer wouldn't have done better to give the order to us . . .

This and that: **Union Carbide** has come up with a new type, long-lasting finish for silver hollow-ware that prevents tarnish and eliminates polishing; probably developed by one of their engineers whose wife made him polish the silverware . . . **William J. Riddell,** assistant design engineer with the Saskatchewan Department of Highways, has been awarded a $2,500 post-graduate scholarship sponsored by Allis-Chalmers . . . **metallurgists at** Jones & Laughlin Steel Corp., Pittsburgh, have developed a series of constructional steels which for the first time combine a very high strength with ease of welding and forming never before available . . . **toothbrushes** flavored with chocolate, vanilla, lemon and other tastes are being offered to small fry across the border to persuade them that dental hygiene is fun; the manufacturer says the brushes, made in accordance with American Dental Association standards, are not really flavored, but only scented to give the impression of flavoring . . .

Within a decade, food will be packaged in containers that are really tiny stoves, says a Massachusetts business man. The housewife will order by phone and the roast will start cooking when it leaves the market. That's all very well, but what about the people living in the outer fringes who don't like overdone meat? . . .

Still looking into the future, one of the electronic marvels displayed by the Pye group at an exhibition of its own products in London was a 3-dimensional television set which it says can be in general use in 50 years . . . other electronic marvels closer to production are devices for locking the doors from your bed and for automatically closing windows when it rains and opening them again when the rain stops . . . **within five years,** it says here, a "package of power" in your basement will light and heat your home, cook your food and even heat your bath water, yet there won't be as much as a pilot light of flame, a whisp of smoke, a whisper of noise or the slightest chance of a power failure . . . **Hamburg** will soon have the world's first remote-controlled subway;

an electrical brain will run the entire system, including train stopping and starting and timetable schedules. . .

More miscellany: **A Kitchener, Ont.** garage operator, Chester Smith, has developed a device which warns the motorist of a leak in his braking system; an auxilliary brake cylinder attached to the firewall actuates a switch to a red warning light on the dash panel . . . **a portable** refrigerator has been developed in Toronto for campers, boaters and travelers; it is powered by your cigaret lighter plug-in or a small can of LP gas . . . **a tape recorder** which allows the user to listen and transmit at the same time has been developed by a Scottish company; it's particularly useful for music and language teaching as the teacher can listen to the playback exercise and interpolate advice or correction . . . **a new "hot shot"** wind tunnel triggering air currents up to 20 times the speed of sound will help scientists find ways to get men back safely from outer space . . . **potential markets** for F-104G attack planes built by Canadian Aviation Electronics Ltd. are Japan, Italy, Belgium and Australia; the Netherlands and West Germany have already placed $18 million orders . . . **if you plan** any construction operations in the Ottawa area, you'll want the geological map of the capital just issued by the Geological Survey of Canada; first of its kind published in Canada, it shows depths through the over-burden to bedrock; next year, a similar map of Montreal Island . . .

Tailpiece: With the World Series behind us, this is as good a time as any to tell of the baseball trainer who died and went to Heaven, where he met up with Babe Ruth, Lou Gehrig, Ty Cobb and all the rest of them. "What a team we could field," he exulted. At that instant the phone rang. It was the man from the other place, suggesting a game with the Heavenly Players. "But what sort of team could you field?" asked the trainer. "Not so good," conceded the Devil, "but don't forget we've got all the umpires!"

"And make sure the line is straight when you put it back."

Hydraulic oil can be safe

Dear Sir:

Concerning C. P. Farr's article on Air versus Oil in your July issue, I object to his statement in the third last paragraph that hydraulic oil may constitute a fire hazard.

It is very easy to purchase non-flammable hydraulic liquids which are also anti-freezing and contain several inhibitors for the prevention of rust oxidation, foaming, etc. Although this fluid is fairly expensive (about $57 a gallon), it is worth it.

Robert B. Masse, P.Eng.
Imperial Oil Ltd.
Montreal

*(Mr. Farr says he was aware of the non-flammable hydraulic liquids on the market. That was why his article said that hydraulic oil "***may** *constitute a fire hazard."—Editor.)*

Needs designer

Dear Sir:

We would appreciate your giving us the names of three or four industrial designers in the Toronto area whom we might contact.

Name withheld

(Reply has been sent by mail. We have withheld the writer's name for obvious reasons.—Editor)

DE keeps me abreast

Dear Editor:

May I compliment you on your July issue. I have found it very interesting and most informative.

I am not an expert in the science of fluid power, but I aim to keep myself abreast of new trends in this field. To do so I keep a permanent record of selected articles and you have six of these selected articles in your July magazine. Consequently, to maintain my filing system up to date, would you be kind enough to send me tearsheets of pages 41 to 61 inclusive of your July literature.

R. L. Hamel,
Project Engineer,
Aluminum Co. of Canada Ltd.
Arvida, P.Q.

Please address letters to
The Editor
Design Engineering
481 University Ave.,
Toronto 2.

Technical literature

Plastic and chemical materials—12-page brochure describing GE's complete line of polycarbonate and phenolic resins, varnishes and molding powders, and fused magnesium oxide. General Electric Co.

Circle 307 on Reader Service Card

Resins, foams and bonding agents — Bulletin containing selector charts for potting compounds, coatings, foams and bonding agents. Plastic Associates.

Circle 308 on Reader Service Card

Laminated plastics — Brochure giving application information and engineering data. Another containing a quick-reference chart of characteristics for 21 commonly used laminate grades. Taylor Fibre Co.

Circle 309 on Reader Service Card

Polyester resins—Report on how three resins withstood a six-month immersion in corrosive solutions. Also a case history bulletin on how reinforced-polyester construction provided the first shortproof welding transformer at the cost of an ordinary unit. Atlas Powder Co.

Circle 310 on Reader Service Card

Reinforced plastics—Brochure on physical properties, cost, methods of manufacture, etc. Protective Plastics Ltd.

Circle 311 on Reader Service Card

Surface conditioning—Brochure on the Perfecto-Peen process for the treatment of surface of materials, primarily metals, by particulate bombardment for the purpose of cold working, cleaning or finishing. Lund Aviation (Canada) Ltd.

Circle 312 on Reader Service Card

Commercial glasses—Booklet setting out for engineers and designers the properties of 32 commercial glasses, with sections on thermal expansion, optical properties, thermal stress, heat transmission, etc. Corning Glass Works.

Circle 313 on Reader Service Card

Counter-timer — Bulletin on a new lightweight unit for timing, measurement, calibration and control requirements for laboratory, industrial and other applications. Radionics Ltd.

Circle 314 on Reader Service Card

Super alloy steels — Technical data book for design engineers on vacuum melting of super alloys, high strength alloys, roll and bearing steels. Midvale-Heppenstall Co.

Circle 315 on Reader Service Card

Granite surface plates — Brochure giving technical answers to a variety of questions about surface plates. Alexander Tools Ltd.

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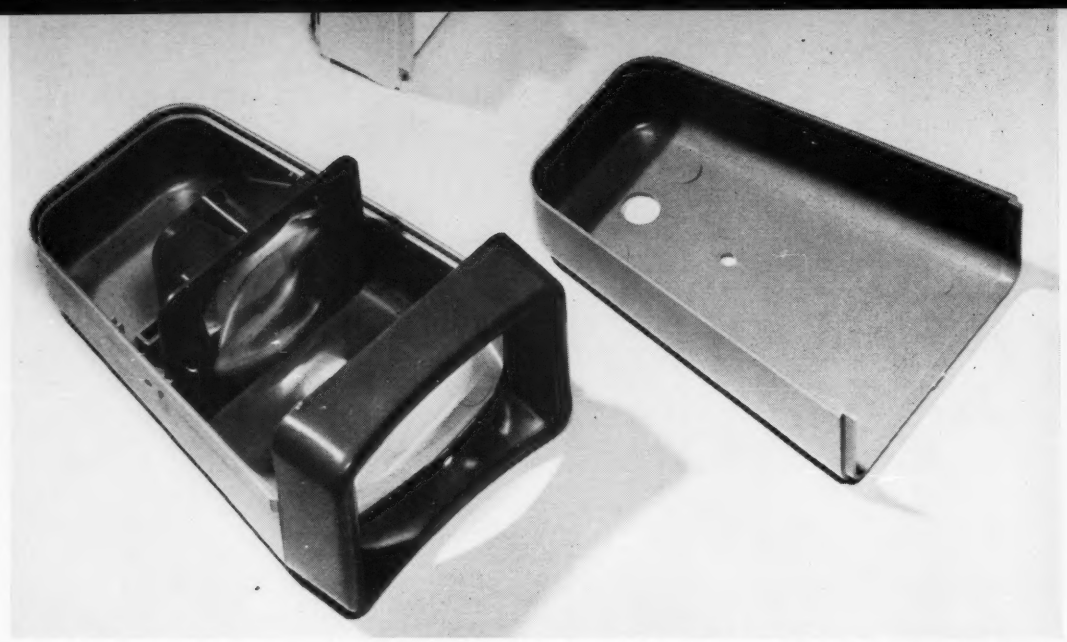


The slide viewer, the casing, even the lenses have been injection molded. The hour-long grinding operation required by optical glass lenses has been eliminated with plastic lenses. Unique mold design features were responsible for this new method of producing optically acceptable lenses of a thickness previously considered impossible.

Should you use custom molded plastics?

Check list here will show if you should investigate them

John Woodruff
Auburn Plastics Inc.
Auburn, N.Y.

New plastics applications have been appearing in such diverse and unlikely industries that practically no manufacturer can rule out the possibility of finding an advantage in plastics. Many managements seeking ways to lower production costs and improve products have found custom molded plastics a way to keep ahead of competition, increase capacity without large capital investment, and open up new markets with new products or new packaging.

To make a quick preliminary survey on whether custom molded plastics fit into your operation, check the questions supplied by Monsanto Chemical Company at the end of this report. Generally it has been found that if you can answer "yes" to any of these, you should investigate how custom molding can favorably fit into your products' profit picture.

In buying custom molding, you are purchasing an engineering and manufacturing service, not merely plastic parts. The plastics industry has grown rapidly in the development of new materials and molding and decorative techniques. Moldings that were impossible just a few years ago, are being successfully run today at astoundingly rapid rates. For example, until recently it has been virtually impossible to obtain rigid polyvinyl chloride in other than extruded forms. For years, industry has successfully used pipes and fittings of this material, but has been unable to take advantage of molded PVC. Recently, a process has been developed by which rigid polyvinyl can be custom molded on modified injection molding equipment.

PVC's high impact qualities are of interest to engineers for many applications presently requiring metal, while its remarkable corrosion resistance makes rigid polyvinyl highly acceptable to the chemical industry. It possesses dimensional stability, excellent dielectric properties and is self-extinguishing without additives. As another example, the unusual properties of nylon can now be utilized in molded sizes and thicknesses which previously had been impossible. Due to a new molding technique, massive sections and solid blocks of nylon can be produced practically and without sinks. A 31-in. propeller weighing 19 pounds is an example.

When you buy custom-molded plastics, the molder, in effect, becomes your plastics department. You obtain the latest technical knowledge and have it applied to your manufacturing operation. You can depend on the molder for proper materials choice, and product or part design that capitalizes on the inherent economic advantages of molding. He will suggest color effects and decorative treatment. Most important, he will have the responsibility of designing a mold that produces consistent quality at the most rapid rates.

In addition you may want to look to the custom molder for such subsidiary services as packaging, palletizing, warehousing and drop shipping. In all cases you will expect him to meet your manufacturing

Continued on page 88

Custom molding *continued from page 86*

schedules.

A qualified custom molder can help you make a detailed assessment of possible product improvements for lowered manufacturing costs. He will probably make a plastic engineering study of your manufacturing operations to determine whether savings or product improvement would result from custom-molded plastics. In looking over your operation, here are some of the things he will do with you:

(1) Examine the parts that are currently being machined, die cast, stamped or formed as likely candidates.

(2) Examine the functions of these parts. Investigate the chemical, mechanical, electrical, thermal and other properties necessary. This will help in the choice of materials.

(3) Study blueprints and samples of these and related parts so he may discover opportunities for savings by manufacturing them in one piece.

(4) Estimate the number of pieces required for immediate use and for long-range ultimate use. This will have a bearing on the kind of mold required. The most common benefit users of molded plastics enjoy is that of making the mold do a lot of work that would otherwise require assembly labor. In other words, a molded piece is so designed to incorporate the functions of other parts used in an assembly.

As in everything else that is manufactured, quantity has a great bearing on your cost per thousand. For example, the cost per thousand for a multiple cavity job can drop as much as 75% as the quantity increases from 25,000 to 2,000,000. Significant savings can also be realized as mold sizes change. Perhaps your plastics parts will be adaptable to automatic presses. On some parts converted to automatic compression presses from conventional presses, we have reduced molding costs 71%. Although the automatic process is not adaptable to all types of compression-molded parts, it definitely has great advantages in areas where it does apply — such as higher quality, consistent and accurate reproduction, and usually considerable savings.

These are reasons why it is important to deal with a molder who has the know-how and facilities to run your job in the most economical manner. Remember that in buying custom molding, you are buying engineering services and knowledge as well as parts. Tell the molder the standard of quality and service you require and then pay the price to obtain it. You will find that it is more economical in the long run. ★

CUSTOM MOLDING CHECK LIST

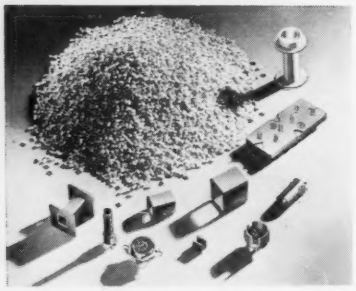
Prepared by Monsanto Chemical Corporation

A "yes" to any of these questions indicates you should investigate custom molded plastics.

Yes	*No*	
——	——	1. Could you realize significant savings in your manufacturing costs by reducing assembly operations?
——	——	2. Do you use 50,000 or more per year of any product or part? (Depending on the job, smaller quantities may also be feasible.)
——	——	3. Do multiple finishing operations run up your production costs? (For instance, do you use parts which must first be cast, then ground, then tapped before they are ready for assembly?)
——	——	4. Do you have frequent rejects or customer complaints because of denting, imperfect finish or poor assembly?
——	——	5. Must any component of your product be sub-assembled before you can assemble the finished product?
——	——	6. Is surface finishing or coloring of your product a separate operation?
——	——	7. Would reduced weight of your product bring about significant savings in shipping charges?
——	——	8. Are you considering a new product, a new part or new package that would require large capital investment which you would like to avoid at this time?
——	——	9. Would a display or re-usable type package help to make sales for you?
——	——	10. Does the maintenance of multiple forming dies run up your manufacturing costs?
——	——	11. Do any of your products or product parts require expensive corrosion- resistant coatings?
——	——	12. Could you operate more efficiently or benefit from increased capacity without large capital investment by "jobbing" out presently required parts or completely new parts?
——	——	13. Could you improve your market position or your profit potential by sub-contracting for the manufacture of new products related to your present line?
——	——	14. Have you previously rejected the possibility of using plastics because your own manpower is not technically trained in producing plastics; an investigation more than two years old showed that plastic materials would not offer the properties you wanted; you were not prepared to make an investment in expensive molding equipment?

New products and materials

Molding composition



Developed chiefly for injection molding, a new molding powder is based on Du Pont's Teflon 100 compounded with inorganic reinforcing materials such as fibre glass and graphite. The powder opens many applications for Teflon previously impractical due to high fabricating costs. Typical applications include coil form and bobbins, tube sockets and connector assemblies for electronic purposes, and incapsulation and lining of valve components for similar parts for chemical service. Crane Packing Co. Ltd.

Circle 317 on Reader Service Card

Phenolic compounds

What are said to be the fastest curing phenolic molding powders are now commercially available. Curing rates 25% faster than those of conventional fast-cure powders have been exhibited. The compounds are designed for both cold powder automatic molding and preheat compression and transfer applications. Typical parts produced are cones, cams, electrical blocks and contact covers, lamp sockets and stove handles. General Electric Co.

Circle 318 on Reader Service Card

Thermoplastic extruder

Features of a new thermoplastics extruder are space-saving design, modular construction and optional liquid cooling. Liquid cooling is said to cool three or four times faster than air and to provide extremely precise control of extruder temperatures, even when processing unstable materials. Basic design of the extruder permits selection of the drive gear ratio, thrust bearing capacity and drive horsepower exactly matched to the extrusion requirements of a particular model. National Rubber Machinery Co.

Circle 319 on Reader Service Card

Urethane rubber

A newly developed urethane rubber has proved eight times better than a conventional elastomer in the covering of a feed roll on a machine handling plastic strands. It was still going strong when it was removed for laboratory study after 225 days. Previously, feed rolls in the same operation had lasted only 28 days. Temperature of the plastic varies from 30 to 70 C. Speeds run up to 320 feet per minute, with approximately 5% slippage resulting from the combination of roll speed and tension. Yet after six months the roll faced with the new Adiprene urethane rubber showed only a trace of surface wear. Du Pont of Canada Ltd.

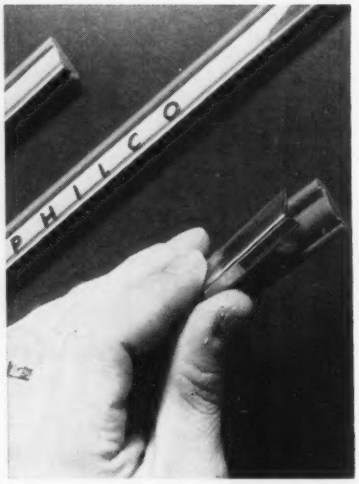
Circle 320 on Reader Service Card

Polyester hose

A new polyamide-polyester hose for hydraulic and other high pressure applications is reported to withstand burst pressures comparable to SAE 100-R1 wire braid hose. Available with reusable and permanently attached couplings, the hose is not affected by non-flammable hydraulic fluids to 200F or flammable fluids to 225F. Imperial Brass Mfg. Co.

Circle 321 on Reader Service Card

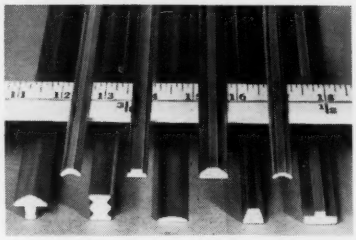
Trim molding



A new two-part trim molding with a mechanical interlocking feature takes full advantage of the resiliency of butyrate and opens a wide field of applications for extrusions. Until this development, plastic trim moldings were usually applied with screws (undesirable because of visible fasteners), glued on (slow and costly) or press-fitted into slots (limited to wood). The new design combines two features—surface mounting and concealed fasteners. Anchor Plastics Co.

Circle 322 on Reader Service Card

Insulating rod



Nine new shapes have been added to a line of fibre glass reinforced polyester extruded rod designed for electrical insulation. The 24 existing sizes are round, square and rectangular. The rod comes in 8 ft lengths. H. P. Ruggles & Co. Ltd.

Circle 323 on Reader Service Card

Polyurethane foam

A new rigid polyurethane foam is said to have several advantages over previous products in this field. It is a two-component package easily measured for mixing by weight, thus eliminating the formerly critical measuring and mixing of catalyst, emulsifier and water. Its slow foaming action allows sufficient time to pour the foam evenly in large cavities. It cures 15 minutes after foaming; bonds strongly to wood, metal and polyester laminates; and can be readily machined with standard woodworking tools. Naugatuck Chemicals, Division of Dominion Rubber Co. Ltd.

Circle 324 on Reader Service Card

Valve tool

A new tool opens valves mechanically, remotely if desired. It consists of an anvil, a hammer and sprocket, and a drive chain. The anvil is clamped or bolted to the existing valve handwheel. A tightly closed valve can be opened by tugging on the chain once or twice to give a jarring action on the handwheel of the valve. It's closed by pulling on the chain. P. J. Houston Enterprises.

Circle 325 on Reader Service Card

Pillow block

A new cast steel pillow block is fitted with a double row of self-aligning barrel roller bearings for high capacity. The cap and base are securely clamped together with high tensile bolts and self-locking nuts. A tapered sleeve provides easy mounting and adjustment. Canadian Pollard Bearings Ltd.

Circle 326 on Reader Service Card

(Continued on page 92)

New products and materials *Continued*

Vinyl tubing

A vinyl tubing which shrinks in size when exposed to heat, yet retains its initial flexibility and electric qualities, has applications in harness cables, condensers, coils, bus bars, high voltage leads, etc. The tubing fits skin tight around contoured shapes, rods or tubes. Controlled shrinkage up to 30 percent in diameter is possible. At 275F the tubing will contract to its final size in 20 minutes; at 300F in four to eight minutes. Minnesota Mining & Manufacturing of Canada Ltd.

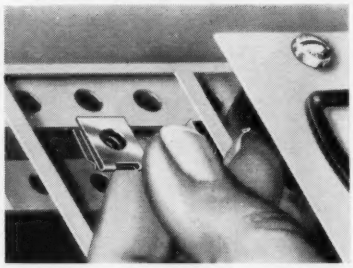
Circle 327 on Reader Service Card

Polyethylene compound

A new high density polyethylene compound for wire and cable applications combines the advantages of greater toughness, high abrasion resistance, reduced compressibility and better heat deflection with greatly improved resistance to stress cracking and thermal embrittlement. In a standard tree wire abrasion test, the compound withstood over 1,500,000 cycles (50% better than other high density polyethylenes); when tested for thermal embrittlement resistance, it exhibited no failures after 5,000 hours of Underwriters' Laboratories heat shock test. Union Carbide Canada Ltd., Chemicals & Plastics Division.

Circle 328 on Reader Service Card

Clip-on receptacle



Riveting and welding are eliminated with a new time-saving clip-on receptacle for use over punched or drilled holes. It slips on in a couple of seconds and locks securely into place. The receptacle can be moved from hole to hole and is easily removed. It's used with a stud and split ring retainer. Southco Division, South Chester Corp.

Circle 329 on Reader Service Card

People . . . . . and events

Seven APEO awards

Engineering students at two Ontario universities who obtained the highest honors in their respective academic years received $250 scholarships last month from the Association of Professional Engineers of Ontario. The awards are presented annually to honor students at the University of Toronto and Queen's.

First, second and third year winners respectively at the University of Toronto were Yiu Chung Li, G. M. Bragg and J. G. Heller, all of Toronto. Winners at Queen's were Edward Langstaff, Rainy River; Stanley E. Frost, Port Hope; and D. Russel Morton, Kingston.

APEO also awards an entrance scholarship in alternative years to U. of T. and Queen's. This year it went to Grant MacLay Davidson, Deep River, Ont., who is taking engineering physics at U. of T.

Monsanto buys Robinson Foams

Robinson Foams Ltd., manufacturers of polyurethane foams, have been acquired by Monsanto Canada Ltd. The Robinson Foam operations will be integrated with those of Monsanto Oakville Ltd., a Monsanto subsidiary making vinyl film sheeting and coated fabrics.

Polyurethane foams are widely used in furniture upholstery and the automotive fields. Their markets parallel the marketing areas of Monsanto Oakville Ltd.

John Inglis appointments

Warnock

Hensman

J. G. Warnock, P.Eng., manager, hydraulics department, John Inglis Co. Ltd., has been named head of a division at the associate firm, English Electric Co. Ltd., England. The division will bring together departments handling water turbines, water wheel generators, valves and associated equipment.

P. S. Hensman, P.Eng., sales and contracts manager of the hydraulics department at John Inglis, succeeds Mr. Warnock as manager of the department.

(Continued on page 94)

People . . . . . and events

continued

Avro has new project

Avro Aircraft Ltd., Toronto, has signed an agreement with United Marine Inc., Millville, N.J., to manufacture aluminum hulls for the power cruisers of United Marine's Richardson Boat division, North Tonawanda, N.Y.

Harvey R. Smith, vice-president of A. V. Roe Canada Ltd., Avro's parent company, says the deal channels Avro's aerodynamic engineering skills into marine development for the first time. Its new marine division would be separate from the company's continuing participation in the aviation industry.

Avro will furnish the hulls complete with tanks, bulkheads and fittings. The hulls will be transported to Tonawanda where superstructure will be completed. For the Canadian market, however, Avro will assemble the cruisers in their entirety, using superstructures, interiors, decks, etc., supplied by United Marine.

Canadian Steel Improvements Ltd., another A. V. Roe company, will join with Avro in the new project.

Jobs through growth

The second industrial development conference of the Ontario Government's Trade and Industry Branch will be held at the Royal York Hotel, Toronto, on November 24 and 25. The theme this year will be "Increased Employment Through Accelerated Industrial Development."

The previous conference, held in 1958, drew nearly 1,000 delegates from the executive rank of business and industry, government and municipal life.

Gets U.S. post

Donald A. Forbes, formerly vice-president and director of research at Hamilton Porcelains Ltd., Brantford, Ont., and extension lecturer on ceramic technology at McMaster University has been appointed chief development engineer, ceramic department, Corning Glass Works, Corning, N.Y. He is a member of the Canadian Ceramic Society and of similar groups in other countries.

Servicing metalworking machines

Pullmax (Canada) Ltd. has been established to service Pullmax metalworking machines manufactured by A. B. Svetsmekano of Gotenberg, Sweden. Machines, parts and accessories are maintained at the plant on South Service Road, Oakville, Ont.

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NOVEMBER — 1960

Thread design in plastic molding

Basic rule is total use of the strength of the screw

Federico Strasser

The production of plastic moldings with threaded holes, is rather common. However, not always are the necessary design and strength considerations taken into sufficient account, in spite of their simplicity.

Threaded holes in plastic moldings can be created in two ways: tapped or pressed. In the first case the molding is produced with a smooth walled hole (corresponding to the thread ID) and tapped with ordinary (or special) taps. In the second case, the threads are produced with special punches during the stamping pressing process.

As found out in tests and actual practice, both kinds of threads have practically the same strength. Since the holes are usually to be employed with metal screws — that is with screws made from a material of much higher strength — this fact must be taken into consideration. And precisely by increasing correspondingly the length of the minimal thread-engagement between screw and nut (this is the whole secret).

It is a basic rule for screw-nut fastening design that the strength of the screw be totally utilized, so that in case of overload the screw-threads are stripped first and not the female threads. In this way, in case of overload, it is the screw — the easier replaceable member — which is ruined.

The strength of a threaded hole in plastic moldings (or for that matter, also in laminated plastics) depends on the following factors: thread engagement length, type of plastic, direction of molding and dimensions of thread.

As average data, following simple formula is recommended (see fig. 1 and 2):

$l = c \times d$ where:

l—minimal thread engagement, in inches
d—thread OD, in inches
c—factor depending upon screw diameter
- c = 3 for very small screws, under 0.1 in. OD
- c = 2.5 for medium screws, between 0.1 in. and 0.25 in. OD
- c = 2 for larger screws, over 0.25 in. OD

Note that in the case of the smaller sizes, the inaccuracies become proportionately larger and thus the female thread strength becomes smaller. This must be compensated for by longer thread-engagement.

If the size of the plastic molding (wall thickness) is not sufficient to providing the necessary "l" value, then following solutions may be employed:

1) Provide a boss, according to fig. 3, whose diameter should be about 3 times thread OD;

2) Substitute the threaded hole by a metallic (threaded) insert of adequate strength (fig. 4).

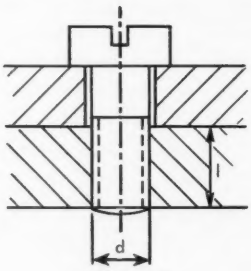

Figure 1

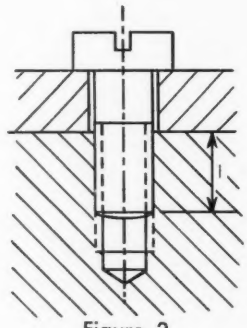

Figure 2

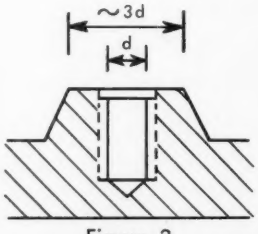

Figure 3

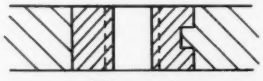
Figure 4

backlash

Interim report

DE's editor Doug Kaill addressed the afternoon session of the first annual meeting of the Fluid Power Society in Chicago on October 19. He reviewed the history of the industry in Canada, its organization and mode of operation. He forecast a major expansion provided the industry could get together on a co-operative promotional program.

The industry's major need, both here and in the United States, is in the field of education. Reports presented at the Chicago seminar showed only too clearly that engineers are not well enough informed to make use of the full potential of fluid power. This lack of knowledge is a major reason the Fluid Power Society was brought into being.

The Society is a technical organization formed to bring together all persons engaged or interested in any activity which may further the development and use of fluid power. Anyone interested in fluid power may join the society, regardless of his educational background or experience. Membership is on an individual basis. Chapters have been established in several cities and it is hoped to organize the first Canadian chapter in Toronto within a few weeks.

A further report will be published in the January issue. Meanwhile those interested may obtain a pamphlet on the Society by writing to the Editor, Design Engineering, 481 University Ave., Toronto 2.

SES honors Canadians

Three Canadians were honored by the Standards Engineers Society at its recent annual meeting in Pittsburgh. Honorary life fellowship was awarded to James Garfield Morrow, OBE, retired chief metallurgical engineer at the Steel Co. of Canada, a fellowship went to David Wolochow, currently secretary of the Canadian Government Specification Board, and a citation to Michael J. McKerrow of Canadian Westinghouse Co. Ltd.

Mr. Morrow was a leader in the field of ABC (American-British-Canadian) standardization activities which produced the unified screw thread standards. He received the American Standards Association medal in 1955. The present award of honorary life fellowship is the highest the SEC can bestow.

Mr. Wolochow received his fellowship for his "years of service and achievements in government standards and his international contributions to contemporary standards bodies." Mr. McKerrow's citation honors his work in international membership, which helped in the establishment of member groups in Britain, India, Holland and other countries.

The 1,000-member society will meet in Toronto in 1965. Next year's meeting will be in Chicago.

Keep it up

It's time to present bouquets. In this column three months ago we begged you to send us letters. Any subject you like, we said, even letters critical of the job we're doing. We said any sort of letter was better than stony silence.

You rose magnificently to the occasion, sending us a small shoal of letters. They have been published in the magazine from time to time and some created sufficient interest to spark further letters. Incidentally there was scarcely a critical note among them.

So: Thank you, dear reader. We appreciate your kindness. But please don't go back to stony silence.

Farewell, dinosaur!

Judging by what one hears, the automobile industry is going through a much-needed revolution. At last they are beginning to think about giving the customer what he wants.

And in our opinion, it's not before time. Too long has the buying public had to accept too much chrome, too much horsepower, and too much car to fit in a standard garage. The fintailed dinosaurs are destined to disappear.

The new breed of cars are not so extravagant in their waste of space, labor and material. However, they are still too extravagant in their price. If foreign-made cars are to be halted in their takeover of the American market, then the price of the homemade products must come down.

But the revolution will not be complete until the industry gives up the practice of built-in, carefully calculated obsolescence. To continue to make a car that will be out of date in one year is sheer folly, and a certain road to industry suicide.

Engineers educate

A series of reports on outstanding engineering projects in Ontario is being distributed to high school students throughout the province. The idea is to keep students and their parents informed about the contribution which engineers make to the economy.

The first report, dealing with the Burlington Bay Skyway, has already been distributed to 51,000 students. Describing the skyway as "one of Canada's proudest achievements," the booklet touches upon its notable features such as the "lateral elevator" built into the bridge to help in the maintenance of the huge structure.

The series is being promoted by the Association of Professional Engineers of Ontario with the co-operation of the Department of Education. Doug Kaill, editor of Design Engineering, is a member of the APEO public relations committee responsible for producing the booklets.

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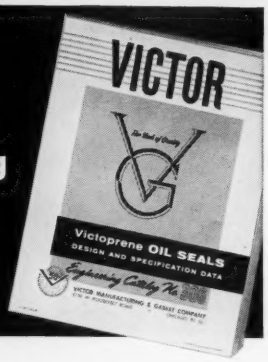

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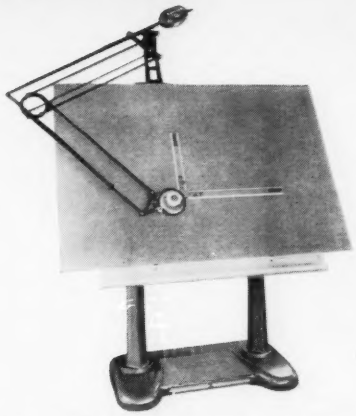

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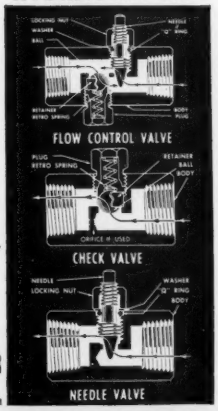
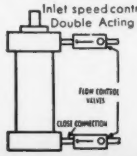
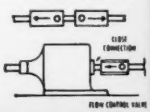


Inlet speed control for Double Acting Cylinder.



Single Acting Cylinder Speed Control.



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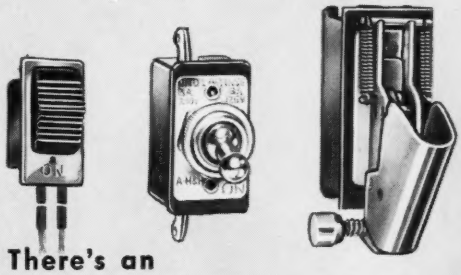

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Editorial

Plastics are on the move in Canada

. . . designers must make every effort to keep pace

Plastics are the wonder engineering materials of the modern age, provided they are properly employed. They have a variety of performance possibilities matched by nothing else, but to reach these potentials may require a special design.

The boom in plastics is one of the biggest events in industrial history. The trouble, though, is that not all engineers have begun to realize it yet.

In another decade or two we designers will be amazed that it has taken so long to accomplish what should have been almost instantaneous, and that is, for plastics to win their proper recognition. Our purpose in presenting this issue of DE devoted to a recital of some of the basic facts on plastics has been to advance that day when all designers will give plastics their rightful place.

The trouble is that the chemists have been outproducing the designers. Almost every day we read of some new synthetic being developed, or a new plastics producing plant going on stream . . . and all the while the designers are feverishly trying to catch up on last week's or even last year's new plastics.

Now it is time for the designer to jump in with both feet. Plastics can simplify manufacturing processes, can reduce tooling work, can cut costs and eliminate waste. And in most cases, can give a better product.

In spite of the thinking of many engineers, plastics are NOT SUBSTITUTE materials, like the "ersatz" products we endured during the last war. Plastics are a new medium — indeed they are a series of media — by which the designer can often improve his product and increase its usefulness.

As designer engineers we should be up and doing now . . . with plastics.

A new showpiece will be unveiled in Canadian industry when the first Canadian Plastic Show opens its doors. General theme of this show will be "Close-up on plastics" . . . an apt description of a vital industrial need.

Although the show is approximately one year away, October 17-19, 1961 to be exact, already the exhibitors list represents every phase of the plastics industry. Machinery companies will have their very latest creations set up and in operation . . . material suppliers will display the expanding uses for their products.

For the design engineer looking for ideas, there will be plenty to see. New applications in plastics will number in the hundreds.

The Society of the Plastics Industry, whom we wish to thank for their part in the preparation of this special issue of DE, will be holding meetings concurrent with the Plastics Show. The show is being sponsored by Progressive Plastics magazine, a Maclean-Hunter contemporary.

Remember the dates and place — October 17-19, 1961, in the Automotive Building, CNE, Toronto. Every design engineer should plan to attend. Watch for further announcements in this publication.

Doug Kaill

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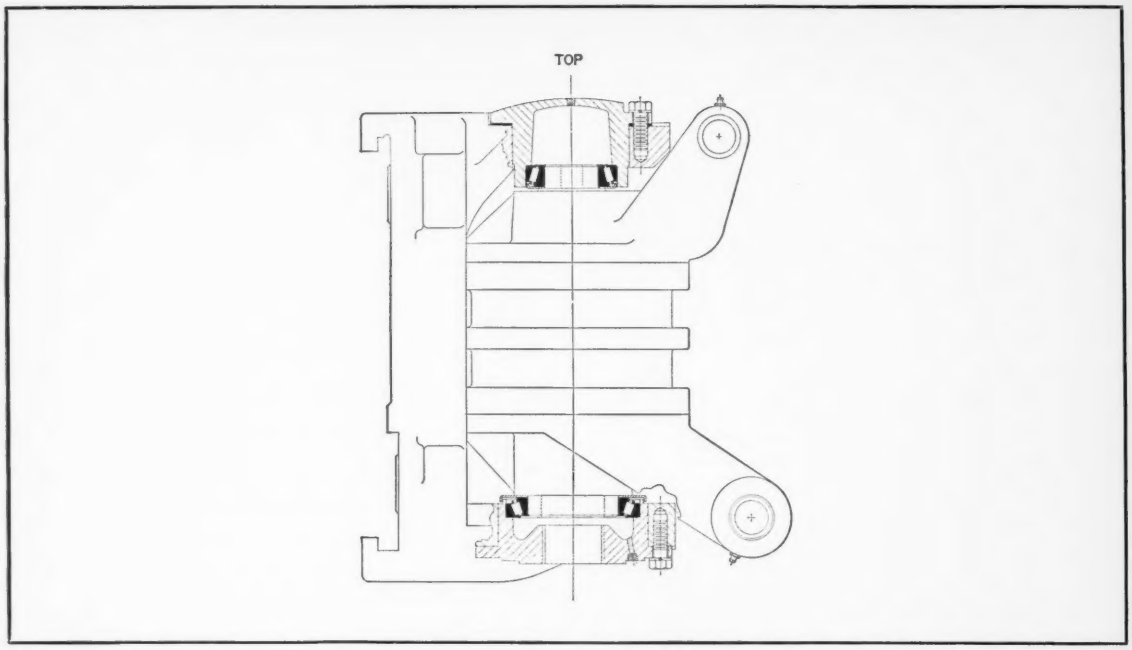
How John Deere assures better boom action, cuts maintenance in "51" Backhoe



To assure extra ruggedness and better boom action in their "51" backhoe, John Deere engineers designed the pivot shaft with Timken tapered roller bearings at both upper and lower ends (above). This design requires unusual rigidity because the swing cylinder is integral with the pivot shaft. Timken bearings help provide this rigidity. And they have the high load-carrying capacity needed in trench-digging and excavating machines.

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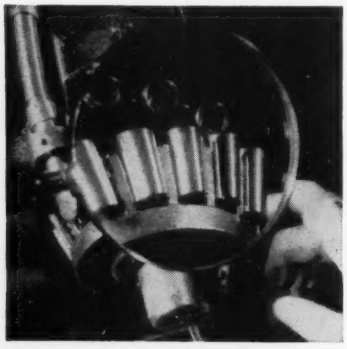

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